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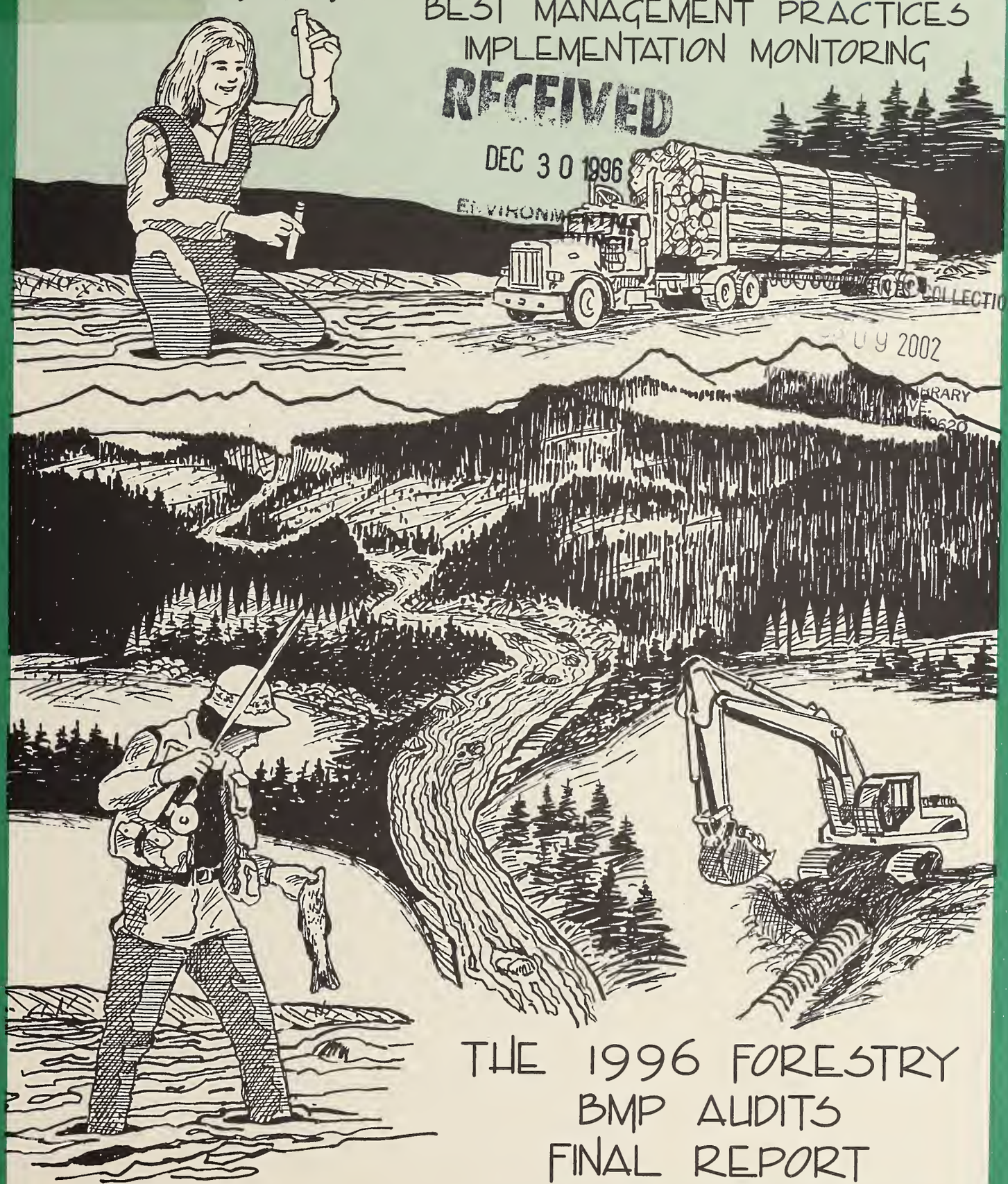

THE 1996 FORESTRY BMP AUDITS FINAL REPORT

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FORESTRY BEST MANAGEMENT PRACTICES

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THE 1996 FORESTRY BMP AUDITS
FINAL REPORT

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MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
FORESTRY DIVISION
MISSOULA, MONTANA 59804

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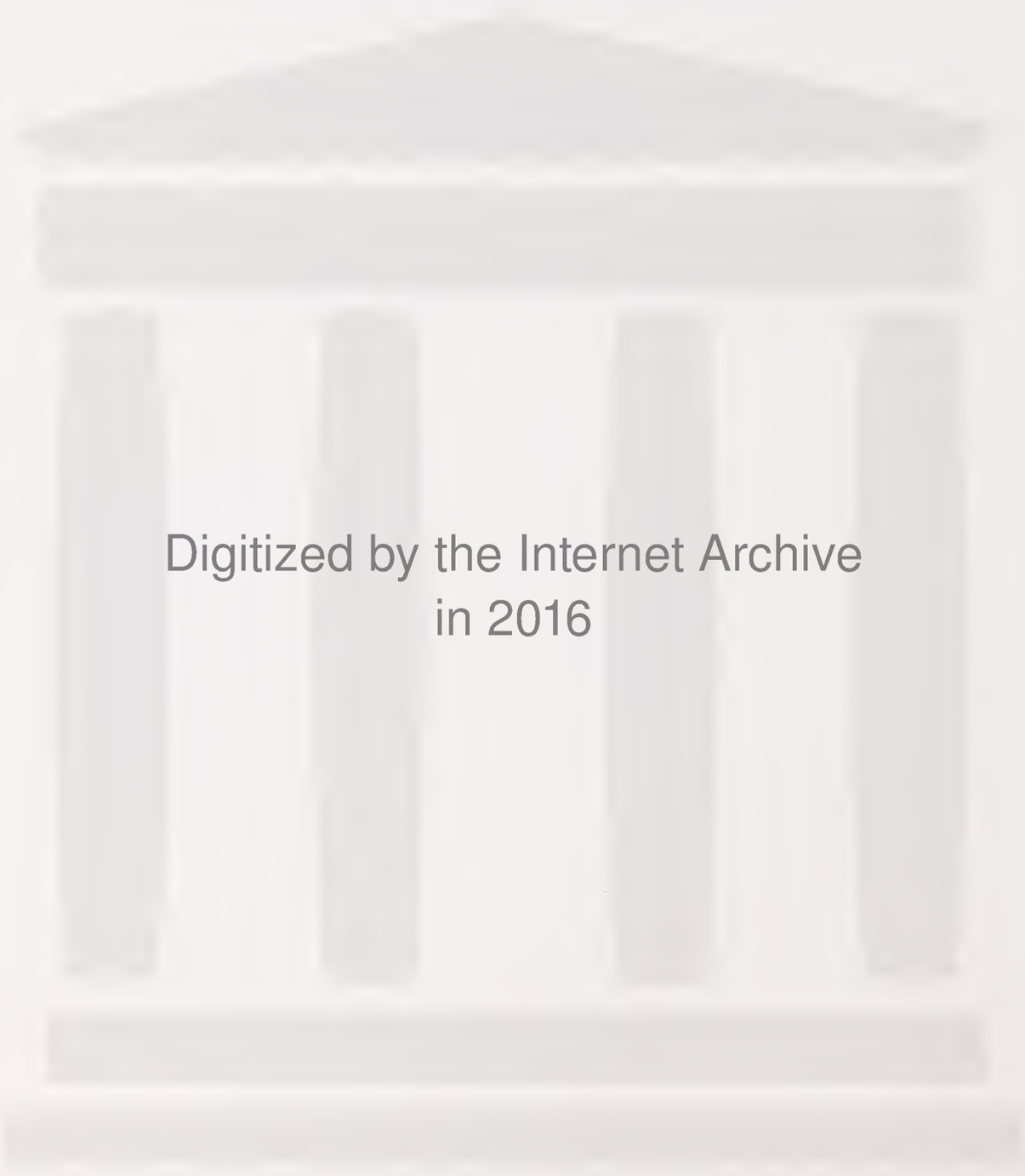
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EXECUTIVE SUMMARY

The Best Management Practice (BMP) audit process is used to evaluate whether BMPs are being applied and if they are effectively limiting non-point source pollution. In 1995 the Governor requested the Montana Department of Natural Resources and Conservation (DNRC), Forestry Division to evaluate forest practices for BMP implementation and report to the EQC before the 1997 legislative session. This report summarizes the findings of Montana's 1996 forestry BMP audits. A similar study and report were completed in 1990, 1992 and 1994.

Three interdisciplinary teams conducted the audits. Each audit team was composed of six members: a fisheries biologist, a forester, a hydrologist, a representative of a conservation group, a road engineer, and a soil scientist. DNRC used site selection criteria to choose 46 timber harvest sites harvested since 1994. The selection criteria limited the sample to those sites most sensitive to the practices that affect water quality. The audit teams evaluated a maximum of 47 practices at each site, rating application and effectiveness for each BMP on a 5-point scale.

The audit teams evaluated 44 sites for **BMP application.** Audit results showed that 92% of the time BMPs were properly applied. Most harvest sites had at least one instance where BMP application was inadequate. However, a majority of these departures were minor and did not cause erosion or deliver material to a stream. Twenty-seven percent of the sites had one or more BMP departures which resulted in some erosion or deposition of material to a stream. Because practices vary greatly in their potential impact, the application of eight high risk BMPs was evaluated separately. High risk BMPs are among those most important for protecting soil and water resources. Eighty-one percent of these high risk BMPs were properly applied.

The audit teams also evaluated **BMP effectiveness**. Audit results showed that 94% of the time BMPs were effective in protecting soil and water resources. Most of the sites had some minor departures in BMP effectiveness. Minor departures in effectiveness produce minor impacts to soil and water resources. Only 34% of the ***sites*** had major departures in BMP effectiveness. Eighty-six percent of the eight high risk BMPs evaluated were rated as providing adequate protection to soil and water resources.

The greatest departure from BMPs, and the most impacts, were associated with road drainage. The text includes a list on pages 25-26 of problematic BMPs and BMPs that are usually applied properly.

The audit teams also evaluated application and implementation of the Montana Streamside Management (SMZ) Law. There were 29 SMZ law infractions noted during all the audits. Most of these were minor and produced no discernible impacts to soil and water resources.

Results for BMP application, effectiveness and SMZ application are summarized by ownership groups below:

PRACTICE	Federal	DNRC	Industrial	Non-Indust. Private
BMP APPLICATION	93%	96%	94%	86%
BMP EFFECTIVENESS	94%	98%	97%	89%
SMZ APPLICATION *	33%	40%	15%	83%

* These numbers represent the percent of sites with at least one instance where the SMZ law was not met.

Similar audits were conducted in 1990, 1992 and 1994 which can be compared to the 1996 results. The 1996 audits show improvement in the application and effectiveness of BMPs when compared with the 1990, 1992 and 1994 results. These comparisons are summarized below:

Comparison of BMP Audit Results - 1996 vs. 1994, 1992 and 1990

	1996	1994	1992	1990
Application of practices that meet or exceed BMP requirements.	92%	91%	87%	78%
Application of high risk practices that meet or exceed BMP requirements.	81%	79%	72%	53%
Number of sites with at least one major departure in BMP application.	12 of 44 (27%)	17 of 46 (37%)	20 of 46 (43%)	27 of 44 (61%)
Average number of departures in BMP application, per site.	3.0	3.9	5.6	9
Number of practices providing adequate protection.	94%	93%	90%	80%
Number of high risk practices providing adequate protection.	86%	83%	77%	58%
Number of sites having at least one major/temporary or minor/prolonged impact.	15 of 44 (34%)	13 of 46 (28%)	17 of 46 (37%)	28 of 44 (64%)
Average number of impacts per site.	2.3	3	4.6	8

Recommendations from 1996 Audit Team Members

- Continue the interdisciplinary forestry BMP audits. The audit process has been fundamental in educating and making people aware of BMP requirements. Conduct the audits every two years.

- Continue to evaluate implementation of the SMZ law and rules.

- Update the BMP audit process to include site selection, clarification and refinement of the BMP's and the audit form.

- Encourage the development of a mechanism to monitor the effectiveness of BMP's.

- Recognize the need to formally involve NIP landowners into the entire BMP audit process.

- Encourage all ownership groups to continue their commitment, involvement and support in the audit process.

- Continue educating loggers, landowners, and foresters, concentrating on problem areas documented through BMP audits. Lack of adequate drainage on new and existing roads continues to be the primary impact to water quality. BMP education should emphasize the need for meeting road drainage BMPs.

- Actively encourage the sites' owners and logging contractors to attend the audit. The Montana Logging Association and the Montana Wood Products Association will assist DNRC in notifying contractors. At a minimum, give contractors a copy of the audit results for their sites.

- The team leader should encourage the landowner and contractor and, if needed in the case of NIP lands, the DNRC Service Forester, to develop a remedy for problems noted. An audit team member will assist if necessary, especially to identify problems. Industry groups, such as MLA and MWPA may participate as needed.

- Continue funding volunteer audit team members.

- Institute a similar BMP audit process for other land uses, including mining, livestock grazing, agriculture and subdivision development.

INTRODUCTION

The forest lands of Montana form the headwaters for several major river basins and produce large quantities of high quality water. This water nurtures some of the West's best fisheries, and is used for irrigation and livestock, as well as for domestic, recreational and industrial purposes. These same lands supply the logs that sustain the forest products industry, an important component of Montana's economy. All products from Montana's 22.5 million acres of forest land contribute in an essential manner to Montana's economy and way of life.

Montana's water quality protection program for forestry involves a combination of regulatory and non-regulatory approaches. Since the 1970's, non-regulatory Forestry Best Management Practices have provided guidance as minimum water quality protection standards for forestry operations.

The BMPs, if properly designed and effectively applied, can limit non-point source pollution--the kind of diffuse pollution that forestry operations often produce, such as sediment from a road or timber harvest. The BMP audit process is used to evaluate whether BMPs are being applied and if they are effectively limiting non-point source pollution.

Concern over the impacts of forest management on Montana's watersheds prompted the 1987 Montana Legislature to pass House Joint Resolution 49. This resolution directed the Montana Environmental Quality Council (EQC) to study "how current forest management practices are affecting watersheds in Montana." The EQC established a BMP technical committee that revised Montana's forestry BMPs in 1989.

Prior to 1990, forestry water quality was addressed through a voluntary approach. In 1989, the Legislature enacted the BMP Notification Law (76-13-101 MCA) which requires private landowners who plan to harvest timber to notify the state of their plans. Under this law, forestry BMP information is sent to landowners. Implementation of practices is voluntary. DNRC Service Foresters review a limited number of high risk sites prior to timber harvest. Nearly all sites on private land reviewed during the 1996 audits were subject to the BMP Notification Law.

Since October 1991, the Streamside Management Zone (SMZ) Law (77-5-301 MCA) regulates forestry practices along streams. This law prohibits certain forest practices along stream channels. The SMZ rules, which were mandated by the law, became effective March 15, 1993 and were intended to help define and clarify the SMZ law. The 1992 BMP audits did not evaluate compliance with the SMZ law because most operations audited were completed prior to the effective date of the law. The 1994 audits, however, were designed to provide preliminary information on the application and implementation of the SMZ law and rules, using a supplemental SMZ questionnaire.

In 1996, a different approach was used to evaluate the SMZ law and rules. The 1994 questionnaire was dropped and nine practices applicable to SMZ's were taken from the BMP's and the SMZ rules, then combined into a rating format. The format was the same as the one used to evaluate the BMP's for application and effectiveness on a 5-point scale. DNRC's intent here was to supply data that would be more easily summarized.

Forestry BMP audits have been conducted previously in Montana. As part of HJR-49, audit teams conducted the first statewide assessment of forest practices for BMPs during the summer of 1988 (Zackheim, 1988). In 1989, the University of Montana, under the Flathead Basin Water Quality and Fisheries Cooperative, audited more sites for BMPs in the Flathead River drainage (Ehinger and Potts, 1990). The Montana Legislature directed DNRC to conduct further series of statewide BMP audits in 1990, 1992 and 1994 (Schultz, 1990 and 1992), (Frank, 1994).

In 1995, the Governor requested the Montana Department of Natural Resources and Conservation (DNRC) Forestry Division to once again evaluate forest practices for BMP implementation and report to the EQC before the 1997 legislative session. This report summarizes the findings of Montana's 1996 forestry BMP audits.

The BMP audit process, which the EPA calls BMP implementation monitoring, is a widely-used means of evaluating forest practices. Implementation monitoring is a surrogate for water quality monitoring, a more quantitative approach. Water quality monitoring is a long-term and expensive endeavor. Water quality varies naturally due to variable geology, land forms, soils, and climatic events. Due to this variability, investigators have to collect large numbers of samples at the right time and over a long period of time to accurately characterize water quality.

Investigators use qualitative implementation audits to find out if BMPs are being applied and whether they are controlling erosion; they can use quantitative water quality monitoring to determine if BMPs are protecting beneficial water uses. Since BMPs are recognized by state and federal legislation as a method to control non-point source pollution, it makes sense to check the application and effectiveness of BMPs as part of such a program. States are increasingly relying on qualitative surveys, using interdisciplinary teams to assess forest practices on-site, to monitor their silvicultural non-point source control programs (NCASI, 1988). California, Idaho, Oregon, Utah, Minnesota, Washington, South Carolina, Texas and Florida all use a similar qualitative approach to assess the control of non-point source pollution from forest practices.

METHODS

The 1996 audits were conducted with similar objectives and criteria as the 1994, 1992 and 1990 audits in order to produce comparable results.

The objectives for the 1990 and 1992 BMP field audits were to:

1. Determine if BMPs are being applied on timber harvest operations.

2. Evaluate the general effectiveness of BMPs in protecting soil and water resources.

3. Provide information on the need to revise, clarify, or strengthen BMPs.

4. Provide information to focus future study efforts by identifying subjects and geographic areas in need of further investigation.

In addition to those listed above, the 1994 and 1996 field audits included one objective concerning the Montana Streamside Management Zone Law and rules:

5. Provide preliminary information on the implementation of the SMZ law and rules and evaluate general effectiveness of SMZs in protecting water quality.

DNRC sought a broad range of participation in planning the 1996 audits, but since the audit was conducted with similar objectives and criteria, less planning was necessary than for previous audits.

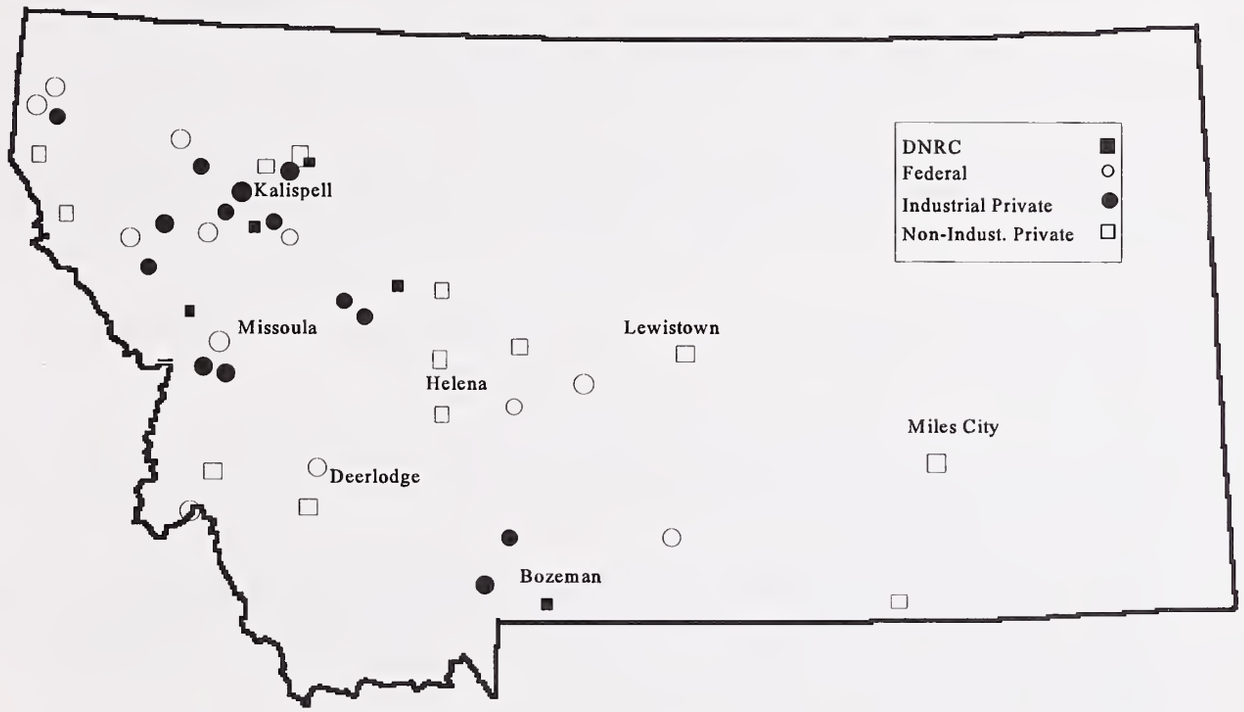
The Audit Teams

DNRC designated three audit teams--one for the northwestern, one for the west central, and one for the southwestern and eastern parts of the State. Each team was composed of six members--a fisheries biologist, a forester, a hydrologist, a representative of a conservation group, a road engineer, and a soil scientist. A member of each audit team was assigned to lead the team. The team leader was responsible for filling out the consensus rating form and for overseeing the logistics of the team. Team members were employees of federal and state agencies, private industry, independent consultants, and volunteers representing several conservation organizations. The Department of Natural Resources and Conservation received a 319 grant from the EPA in part to pay volunteer members who could not participate as a part of their regular job. Continuity in team membership was excellent. Fifteen of the 18 team members from the 1994 audits participated in the 1996 audits. DNRC named an alternate for each member in order to ensure a full range of interdisciplinary participation at each site. Most of the alternates had also participated in the 1994 audits. See Appendix A for a complete list of team members.

Photo #1. Northwest Audit Team and Observers Filling out Rating Form.

The Study Area

The Department expanded the study area to include the eastern half of the State in the 1994 and 1996 audits. During the 1990 and 1992 audits the study area was limited to the western half of the state, where a majority of the timber harvest had occurred. Since that time, there has been a substantial increase in the volume of timber harvested in Eastern Montana. Approximately 44% of the statewide Non-Industrial Private harvest volume in 1994 came from east of the Continental Divide.



Site Selection

The criteria for selecting sites were similar to the 1990, 1992 and 1994 audits, with an updated time frame. The purpose in defining the criteria was to concentrate on sites that were more likely to have potential for water quality impacts. The selection criteria limited the sample to only those timber harvest sites most sensitive to the practices that affect water quality. Selecting the sites was the responsibility of DNRC.

The initial criteria for selection were:

- Sites were selected from areas with timber harvested in 1994, 1995, or 1996. Priority was given to most recently harvested sites.

- A portion of the sale needed to be located within 200 feet of a stream (see BMP definition).

- Minimum size for harvest units to be included in the audit process was five acres. Minimum timber removal was 5,000 board feet per acre. For east-side sales, some flexibility was allowed if smaller or low volume harvest met other criteria.

- The distribution of audit sites reflected the distribution of timber harvest in Montana, geographically, and by ownership group.

- Sites were classified into four land ownership classes--Nonindustrial Private, Industrial Private, Federal, and State. The number of sites per ownership group was to be proportional to the volume of timber each group harvested in 1994, the latest complete reporting period. A minimum of five sites per ownership class was audited.

For sites that met the initial criteria, DNRC made further stratification:

- Sites which included harvesting within 200 feet of a stream and had road construction or reconstruction with a stream crossing and slash disposal completed were given first priority.

- Sites with streams adjacent to harvesting, road construction or reconstruction but slash disposal not complete were given second priority.

- Sites with a stream adjacent to harvesting with slash disposal complete, but no road construction or reconstruction was given third priority.

- Sites were further stratified by erosion hazard. Two-thirds of the audits were located on high erosion hazard sites. One-third were to be located on low to medium erosion hazard sites. This stratification was subject to availability of sites in the various hazard groups.

  Erosion hazard was determined as a function of slope steepness and erosivity based on geologic parent material and soil texture. Erosion hazard was stratified by ownership class so that a disproportionate number of high hazard sites did not fall in any one ownership class. Erosion hazard was determined using an erosion hazard matrix developed through the Montana Riparian Association. See Appendix B. Timber harvest in riparian zones was categorized as high hazard.

The number of days team members would be able to conduct audits limited DNRC to choosing 46 sites for the teams to visit. Two Non-Industrial Private sites fell out of the selection pool due to uncontrollable circumstances. As a result, 44 total sites were reviewed by the Audit teams. The maximum time commitment for audit team members was set at 10 days, since a longer commitment would likely jeopardize the ability of individuals to participate. On most days, teams could audit a maximum of two sites. See Appendix E for the list of sites. The four ownership groups and number of sites audited were:

Ownership Group	Number of Sites Audited			
	1996	1994	1992	1990
Federal (USFS)	12	14	16	16
Industrial Private	14	14	16	16
Non-Industrial Private	13	13	9	7
DNRC	5	5	5	5
TOTAL	44	46	46	44

The goal for the audits was to have two-thirds of the sites in the "high hazard" category, as explained in the criteria for selecting sites. In order to meet the high hazard criteria, a site had either to rank high in a risk matrix that considers slope steepness, soil erodibility, and type of operation, or to be in a riparian zone. See Appendix B. Table 1 shows the percent of audited sites that, based on field evaluation, met the high hazard criteria, whether included by matrix, riparian, or both. Three-quarters of the total sites audited were high hazard. This is similar to the number of high hazard sites in 1990, 1992 and 1994.

Table 1

Percentage of Sites Meeting High Hazard Criteria

Ownership Group	Number of Sites	Matrix	Riparian	Matrix, Riparian or Both
Federal	12	67%	42%	58%
Industrial	14	86%	71%	100%
NIP	13	46%	46%	62%
State	5	80%	60%	80%
All Sites	44	68%	55%	75%

Members of all the ownership groups provided excellent cooperation in assisting DNRC with site selection. Industry and government supplied all information requested, and in most cases, in a very timely manner. DNRC acquired the information about recent timber sales as follows: The affected National Forests and BLM searched their recent timber sales for sites that met some or all of the criteria. No BLM sites were supplied to DNRC that met the initial site selection criteria; therefore, only USFS sites were used to represent (FED) ownership. DNRC finished refining the search where needed. For non-industrial and industrial private lands, DNRC searched Hazard Reduction Agreements and Master Hazard Reduction Agreements for sites that met the criteria. DNRC searched its own timber sale accounting program for state sites that met the criteria.

DNRC listed sites that met the criteria, by region within ownership groups. Sites to be audited were selected randomly from the pool of suitable sites within each ownership group. Only those sites with potential to impair water quality were judged to be suitable.

In the case of non-industrial private lands, DNRC contacted landowners for permission to visit their lands. Participation by NIP landowners was very high. After a DNRC representative contacted non-industrial landowners, a follow-up letter was sent to each landowner explaining the purpose of the audit process as well as DNRC's policy toward enforcement actions. Access to the other ownership groups was not an issue.

The size of audited sites varied greatly. See Table 2 for information on size of harvest units evaluated by ownership group. On very large sites, time did not allow the teams to review every acre of the site or every segment of new or existing roads. Teams concentrated on areas with the greatest potential for problems.

Table 2

Size of Harvest Units Evaluated by Ownership

Ownership Group	Number of Sites	Average Unit Size (Ac.)	Maximum Unit Size (Ac.)	Minimum Unit Size (Ac.)
Federal	12	40	110	12
Industrial	14	63	238	10
NIP	13	54	150	10
State	5	42	118	10
All Sites	44	47	238	10

Sample Size

Because the total number of cutting units in the State is not known, it is not possible to say what percentage of them the 44 sites represent. It is a representative sample of logging operations conducted in Montana since 1994 that meet the selection criteria. The selection criteria limited the sample to only those timber harvest sites most sensitive to the practices that affect water quality. The results are indicative of conditions for sites with potential to impair water quality. **The results do not represent a sample of all timber harvest operations in Montana.** The 44 sites represented approximately 1% of the total volume harvested in the state for the study period.

The Rating Form

The audit teams used a rating form similar to that of previous audits. See Appendix C for a copy of the form. The form was slightly revised for the 1996 BMP field audits to clarify unclear, incomplete or misleading statements. A new SMZ rating section was added while the

1994 SMZ questionnaire was dropped. The new SMZ section eliminated some of the old SMZ/BMP ratings. All of the revisions were made with the goal of keeping the format consistent with that used in past audits. The guide for rating application and effectiveness was the same as used in the previous audits. The audit teams evaluated a maximum of 47 practices at each site, rating application and effectiveness for each on a 5-point scale.

The audit team rated the application of BMPs by first noting if the BMP was applicable to the site; if so, whether it was applied correctly and in the proper locations. Lack of adequate application or misapplication are departures from BMPs. The rating guide for application of BMPs was:

5 - Operation exceeds requirements of BMP.
4 - Operation meets requirements of BMP.
3 - Minor departure from intent of BMP.
2 - Major departure from intent of BMP.
1 - Gross neglect of BMP.

The following description of the rating guide is adapted from Ehinger & Potts, 1990. Ratings of 5 and 4 are self-explanatory. The 3 rating, minor departure, applies to departures of small magnitude distributed over a localized area, or over a larger area where potential for impact is low. The 2 rating, major departure, applies to departures of large magnitude or BMPs being repeatedly neglected. The 1 rating, gross neglect, applies where risks to soil and water resources were obvious and yet there was no evidence indicating that operators had applied BMPs to protect these resources.

The effectiveness rating answered questions concerning impacts. For example "has the application or misapplication of a particular forest practice increased the likelihood of, or actual occurrence of, sediment delivery to streams?" Lack of effectiveness results in impacts. The rating guide for effectiveness was:

5 - Improved protection of soil and water resources over pre-project condition.
4 - Adequate protection of soil and water resources.
3 - Minor and temporary impacts on soil and water resources.
2 - Major and temporary, or minor and prolonged, impacts on soil and water resources.
1 - Major and prolonged impacts on soil and water resources.

The work group defined these terms prior to the 1990 audits to help the audit teams use them consistently:

Adequate - Small amounts of material eroded; material does not reach draws, channels, or floodplain.
Minor - Some material erodes and is delivered to draws but not to stream.
Major - Material erodes and is delivered to stream or annual floodplain.
Temporary - Impacts lasting one year or less; no more than one runoff season.
Prolonged - Impacts lasting more than one year.

The audit teams used a flow chart to help rate application and effectiveness and, again, to keep the rating consistent. See Appendix D.

Audit Site Inspections

The first audit site inspection served as a calibration audit for the teams. Since most team members participated in previous audits, this session served as a refresher. The goal was to have the audit teams establish a consistent method of rating that could carry through the rest of the audits. Team members and alternates met for several hours of classroom instruction on the BMP audit process, and then evaluated the first audit site in the field. The team members shared their results with the other members, and identified and discussed their differences and ways to be consistent.

Photo #2. Southwest Audit Team Filling out Rating Form.

The teams conducted the audits June through August of 1996. The field routine consisted of meeting at a central location in the morning of each audit day. Teams traveled to the audit site. On site, the team leader provided maps and audit forms. Usually a representative of the landowner briefed the team by giving background information on the silvicultural prescription, time of operation, and associated practices. Team members walked the site, reviewing potential impact areas such as roads, streams, streamside management zones (SMZs), skid trails and firelines. Teams typically spent about two hours inspecting each site.

After finishing the inspection, the team gathered to discuss the rating while still on site. The team leader was charged with leading the discussion and recording the consensus rating for each item on the rating form. For ratings where the team could not reach a consensus, the team took a vote and recorded the rating with the most votes. The team leader noted

dissenting values in the Comments section. Teams almost always reached a consensus. Only two individual ratings came to a vote. This number is down from 32 in the 1994 BMP audits.

Limitations of the Audit Methods (in part, adapted from Idaho DHW, 1989.)

In analyzing the audit results, readers need to consider the limitations of the techniques used in the audit. The audit technique consisted of a one-time field inspection and assessment. This approach documents erosion and sedimentation problems which occur in the first or second year after harvest. This is generally the critical period for erosion associated with timber harvests. Some practices conducted during harvest cannot easily be evaluated in post-harvest audits. The assessment was based on visual appraisals of practices and impacts to surface soils and streams. The results are a snapshot-in-time of the practices and subsequent impacts. They do not necessarily reflect future impacts.

Sites were split among three teams. There are likely some differences in how the teams may have rated individual items. Lack of consistency is probably not a big problem, based on discussion with other teams and through overlap of team members on some audits, but it should not be overlooked.

Also, auditors may rate several practices connected with one action. In some cases, one action may result in more than one rating. For example, if a skidder operates extensively in the Streamside Management Zone, the practice may rate poorly under both "Adequate SMZ Maintained" and "Equipment Operation Minimized in SMZ." Even given these limitations, the BMP audit process is an effective way to evaluate the implementation of BMPs. In addition, the audit process has helped promote BMPs and encouraged landowners and operators to protect water quality on managed forests.

Photo #3. Audit Team Inspecting a Skid Trail Water Bar.

RESULTS

The results of the 1996 BMP field audits are presented in several categories, including application of BMPs and SMZs effectiveness of BMPs and SMZs, a supplemental question on cumulative watershed effects, the SMZ law and rules evaluation, and the comparison of the 1996 results with previous audit results.

There are several ways to analyze and summarize the qualitative data generated by this study. One method is simply to look at what percent of the practices audited for BMPs fell into each rating category, by ownership group. This information is presented, for application and effectiveness of BMPs respectively, in Tables 3 and 6. While this is useful information for some purposes--including documenting problem BMP areas and comparing these results with other audits--readers should not base their conclusions on these simple percentage ratings. Appendix F tabulates how the ownership groups complied with each BMP.

All the practices evaluated in the audits can have an effect on water quality, but vary greatly in their potential impact. For example, BMPs in the "Road Planning and Location" section do not have as direct a potential impact on water quality as the practices in "Providing Adequate Road Surface Drainage" or "Adequate SMZ Maintained."

Photo #4. Slash Filter Windrow.

High Risk BMPs

Focusing on the simple percentages will not give a clear picture of how well or poorly Montana's watersheds are being protected. Even a low percentage of misapplied BMPs can still result in serious impacts. To provide several perspectives, the data has been analyzed in different ways. In particular, a subset of eight high risk BMPs has been analyzed separately. These eight high risk BMPs are among the most important for protecting Montana's watersheds. The eight high risk BMPs are:

BMP Number	Practice Description
I.C.1	Provide adequate road surface drainage for all roads.
I.C.6	Route road drainage through adequate filtration zones before entering a stream.
I.D.2	Stabilize erodible soils (i.e., seeding, benching, mulching).
I.E.2	Maintain erosion control features (dips, ditches and culverts functional).
II.A.5	Design and locate skid trails to avoid concentrating runoff.
II.C.2a	Adequate drainage for temporary roads, skid trails, fire lines.
II.D.9	Limit water quality impacts of prescribed fire.
III.C.3	Prevent erosion of culvert and bridge fills (i.e., armor inlet and outlet).

The results for application and effectiveness of the eight high risk BMPs is presented in Tables 4 and 7, and Figure 1. Tables 5 and 8 summarize the data on a site basis, displaying the percent of sites with departures or impacts and the average number of departures or impacts per site.

Some Practices Not Rated

The number of practices rated represents 79% of the total possible number of practices. Some BMPs did not apply to a site: some sites did not have stream crossings or new road construction; most sites did not have borrow pits; in several instances, slash disposal and site preparation had not been completed. In other cases, the audit team could not rate the BMP at the time of the audit--BMPs having to do with timing of operations during the harvest cannot be judged post-harvest.

Application of BMPs

The application rating measures whether the BMP was applied, whether it was applied correctly, and whether it was applied in the proper locations. See "The Rating Form" section on pages 12-14 for further explanation of the application rating. The audit teams evaluated a total of 1,641 practices to assess how landowners and operators applied BMPs. Table 3 lists the percent of practices that fell in each application rating category, by ownership group. Rather than focusing on simple analysis, the reader should refer to other tables (Tables 4, 5, 7 and 8) that better indicate how well Montana's watersheds are being protected.

Table 3

Application of BMPs to All Rated Practices by Ownership Group and Rating Category

Ownership Group	# Practices Rated	Percent (%) Practices Rated As			
		Meet or Exceed	Minor Departures	Major Departures	Gross Neglect
Federal	433	93%	6%	1%	0%
Industrial	549	94%	6%	<1%	0%
NIP	454	86%	10%	4%	0%
State	205	96%	4%	0%	0%
All Sites	1,641	92%	7%	1%	0%

Photo #5. Audit Team Evaluating Harvest Unit.

Table 4 shows the BMP application for the eight high risk BMPs that were evaluated separately (see page 17). The percent of practices with departures is higher for the high risk group (Table 4) than for all audited practices (Table 3), as shown in Figure 1.

Table 4

Application of High Risk BMPs
by Ownership Group and Rating Category

Ownership Group	# Practices Rated	Percent (%) Practices Rated As			
		Meet or Exceed	Minor Departures	Major Departures	Gross Neglect
Federal	87	85%	13%	2%	0%
Industrial	103	83%	17%	0%	0%
NIP	91	73%	21%	6%	0%
State	39	87%	13%	0%	0%
All Sites	320	81%	16%	3%	0%

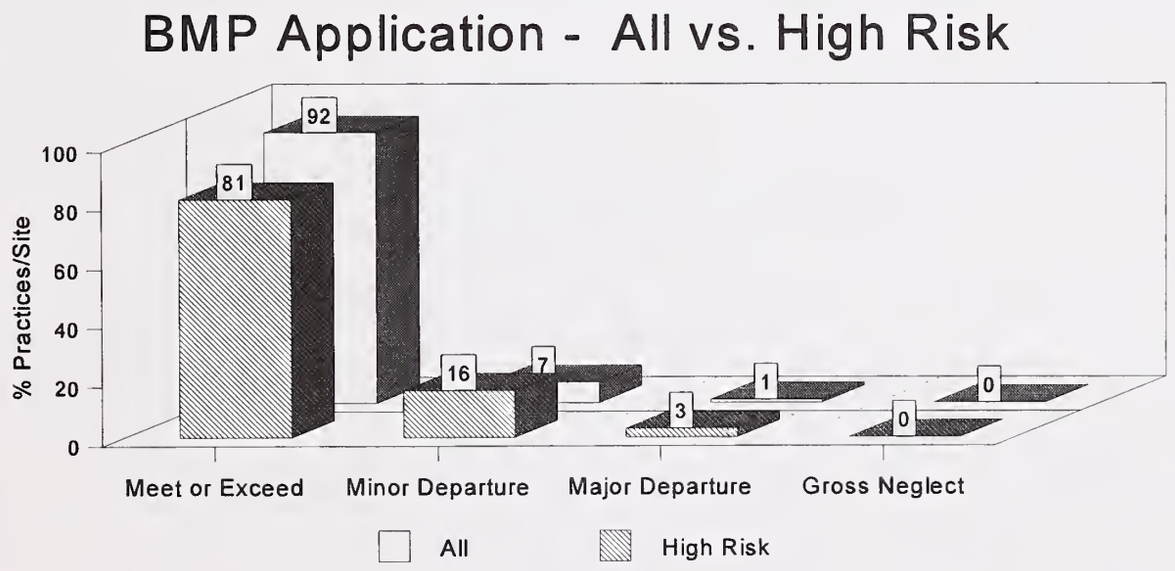


Figure 1.

Photo #6. Audit Team Member Inspecting Culvert Alignment.

Table 5 shows what percentage of sites departed from BMPs, and the average number of departures per site. The average number of departures per site includes all the sites, not just the sites with departures. Table 5 shows that most sites 89%--39 of 44--had at least one minor departure. It also shows that 27%--12 of 44--sites have at least one major departure in BMP application.

Table 5

Audit Sites with Departures from BMP Application and Average Number of Departures per Site

		Percentage (%) of Sites with Departures			# of Departures/Total # of Sites = Ave. #/Site		
Ownership Group	Total # of Sites	Minor	Major	Gross	Minor	Major	Gross
Federal	12	83%	33%	0%	2.3	.42	0
Industrial	14	93%	7%	0%	2.1	.07	0
NIP	13	85%	54%	0%	3.4	1.4	0
State	5	100%	0%	0%	1.6	0	0
All Sites	44	89%	27%	0%	2.5	.55	0

Effectiveness of BMPs

The effectiveness rating evaluates how well BMPs protected soil and water resources. See page 13 for further explanation of the effectiveness rating. The audit teams evaluated a total of 1,641 practices to see how effective the BMPs were. Table 6 provides a summary of the effectiveness of all practices audited, by ownership group.

As with the corresponding table for BMP application (Table 3), the effectiveness information (Table 6) should be used with discretion. While simple percentage ratings may be relatively high for the category Adequate Protection, poor effectiveness of a single BMP may still result in impacts.

Table 6

Effectiveness of BMPs for All Rated Practices by Ownership Group and Rating Category

Ownership Group	Number of Practices Rated	Percentage (%) Practices Rated As			
		Adequate Protection	Minor/Temp. Impacts	Major/Temp., Minor/ Prolonged	Major/ Prolonged
Federal	433	94%	4%	2%	0%
Industrial	549	97%	3%	<1%	0%
NIP	454	89%	7%	4%	0%
State	205	98%	2%	0%	0%
All Sites	1,641	94%	4%	2%	0%

Photo #7. Audit Team Inspecting the Effectiveness of a Road Drainage Structure.

Figure 2 presents the percent of practices audited that are contributing to impacts by ownership group. This figure shows differences among ownership groups in effectiveness of their BMP implementation.

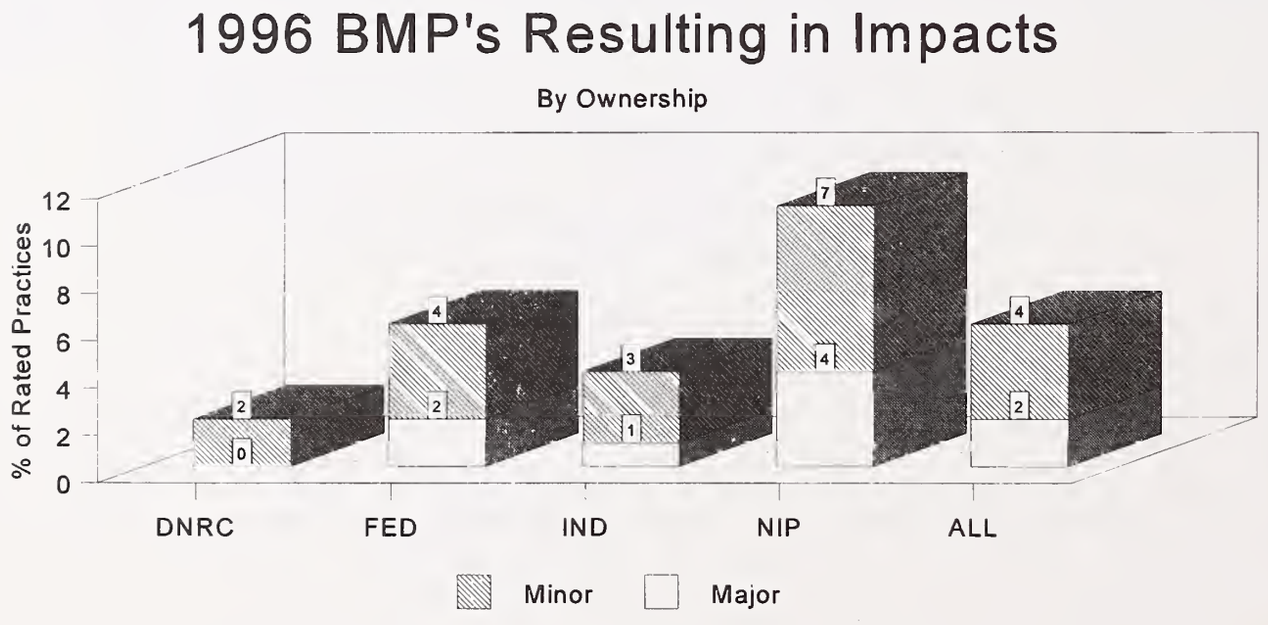


Figure 2

Table 7 shows the effectiveness of the eight high risk BMPs listed on page 17. The percent of practices providing adequate protection is lower for the high risk BMPs than for the total BMP results presented in Table 6. The percent of practices resulting in impacts are higher for the high risk BMPs than for practices in general.

Table 7

Effectiveness of High Risk BMPs by Ownership Group and Rating Category

Ownership Group	Number of Practices Rated	Percentage (%) Practices Rated As			
		Adequate Protection	Minor/Temp. Impacts	Major/Temp., Minor/ Prolonged	Major/ Prolonged
Federal	87	84%	9%	7%	0%
Industrial	103	84%	9%	0%	0%
NIP	91	84%	14%	7%	0%
State	39	90%	10%	0%	0%
All Sites	320	86%	11%	3%	0%

Table 8 lists the percentage of sites with impacts and average number of impacts per site. This table shows that 66% of the sites audited were producing at least minor/temporary impacts--at an average of 1.6 per site. Thirty four percent of all sites were producing major/temporary impacts--an average of 0.66 per site. This analysis illustrates that, while the percentage of practices rated as providing adequate protection may be quite high (86%), impacts were still occurring on a majority of the sites audited.

Table 8

Audit Sites with Impacts and Average Number of Impacts per Site

Ownership Group	Total # of Sites	Percentage (%) of Sites with Impacts			# of Impacts/Total # of Sites = Ave. #/Site		
		Minor/ Temp.	Major/Temp., Minor/ Prolonged	Major/ Prolonged	Minor/ Temp.	Major/Temp., Minor/ Prolonged	Major/ Prolonged
Federal	12	67%	50%	0%	1.5	.83	0
Industrial	14	71%	7%	0%	1.2	.07	0
NIP	13	69%	62%	0%	2.5	1.40	0
State	5	40%	0%	0%	1.0	0	0
All Sites	44	66%	34%	0%	1.6	.66	0

Cumulative Watershed Effects

The audit teams asked audit site representatives the following supplemental question addressing cumulative watershed effects:

> Were any CWE assessments or watershed analyses included in the timber harvest planning?
>
> If yes, what type and level of analysis was carried out (i.e., monitoring, screening, CWE indices, interdisciplinary teams, assessments of changing geomorphic processes or a combination of two or more).

The table below reflects the sites that included some type of CWE assessment into the harvest plan.

Ownership Group	Sites Where Landowners Assessed Cumulative Effects
Federal	12 of 12 = 100%
Industrial	6 of 14 = 43%
NIP	2 of 13 = 15%
State	5 of 5 = 100%
All Sites	25 of 44 = 57%

There were 25 of 44 sites that included some type of assessment. The table below reflects the four types of assessments and their percentage of occurrence.

Assessment Type	% of Occurrence
CWE Indices	4 of 25 = 16%
ECA Analysis	4 of 25 = 16%
Model	10 of 25 = 40%
Preliminary Screening	7 of 25 = 28%

DISCUSSION

Table 3 indicates that 92% of the practices applied on all sites met or exceeded BMP standards. This type of analysis does not accurately represent the impact that practices have had on the audited sites. Not all practices are equally important for protecting water quality. 81% of high risk BMPs, as listed in Table 4, met BMP requirements.

Eleven percent of the high risk BMPs resulted in impacts, as shown in Table 7. Table 8 indicates that 66% of the audited sites (29 out of 44) produced minor/temporary impacts and 34% (15 out of 44) produced either major/temporary or minor/prolonged impacts. No sites produced major/prolonged impacts. Most of these impacts could have been prevented if landowners and operators had properly applied BMPs.

As was true for the 1990, 1992 and 1994 audits, the results of the 1996 audits show that the greatest departure from BMPs, and the most impacts, were associated with road drainage. Improper installation of or lack of slash filter windrows, insufficient maintenance of erosion control features and drainage and poor skid trail design, location, and drainage also resulted in a large number of deficiencies in application and impacts.

The list that follows is of individual BMPs that most often are not properly applied or result in impacts, ranked in order, by the sum of departures and impacts. Rankings from the 1990, 1992 and 1994 audits are listed in parentheses. An (-) indicates not frequent enough to be in the top list for that year.

1996	1994	1992	1990	Practice Description	Practice #
1.	(1.)	(3.)	(1.)	Provide adequate road surface drainage for all roads.	I.C.1
2.	(4.)	(-)	(5.)	Slash filter windrows installed.	I.D.3
3.	(3.)	(13.)	(19.)	Direct road drainage away from stream crossing site.	III.B.1b
4.	(9.)	(10.)	(2.)	Prevent erosion of culvert and bridge fills.	III.C.3
5.	(5.)	(-)	(10.)	Maintain erosion control features (dips, ditches, and culverts functional).	I.E.2
6.	(-)	(12.)	(-)	Cut and fill slopes at a stable angle.	I.D.5
7.	(2.)	(2.)	(3.)	Route road surface drainage	I.C.6
8.	(8.)	(15.)	(4.)	Stabilize erodible soils (i.e. seeding, benching, mulching).	I.D.2
9.	(6.)	(1.)	(6.)	Adequate drainage for temporary roads, skid trails, and fire lines.	II.C.2a
10.	(-)	(-)	(-)	Skew ditch relief culverts.	I.C.2
11.	(7.)	(5.)	(9.)	Design and locate skid trails to avoid concentrating runoff.	II.A.5
12.	(14.)	(-)	(-)	Avoid incorporating woody debris in road fills.	I.D.6
13.	(-)	(-)	(-)	Excess materials placed in locations that avoid entering a stream.	I.D.8
14.	(11.)	(-)	(-)	Provide energy dissipators at drainage structure outlets where needed.	I.C.4
15.	(-)	(6.)	(16.)	Limit water quality impacts of prescribed fire.	II.D.9
16.	(-)	(7.)	(15.)	Grade roads to maintain drainage.	I.E.1

These 16 practices accounted for 84% of all departures and 79% of all impacts. The remaining BMPs had a lower frequency of departures in application or resultant impacts.

The following practices were on the 1994 list of BMPs most often not applied or resulting in impacts but did not make the list in 1996. The number in pparentheseson the left is the ranking from the 1994 report.

(10.)	Culverts conform to natural streambed and slope	(IIIC2)
(12.)	Reconstruct only to the extent necessary to provide adequate drainage and safety.	(ID10)
(13.)	Skidding operation minimizes soil compaction and displacement.	(IIC1a)
(15.)	Locations avoid high hazards sites (i.e., wet areas and unstable slopes).	(IA4)
(16.)	Streams free of logging debris.	(IIB4)
(17.)	Vary road grades to reduce concentrated drainage.	(IB4)

On the positive side, the 1996 audits showed that the following BMPs were nearly always properly applied, resulting in few impacts (two or fewer minor/temporary impacts).

- Most BMPs related to road planning and location (I.A).
- Designing roads to minimum standard necessary to accommodate uses (I.B.2).
- Proper sizing for crossing structures (I.B.5).
- Suitable logging system for topography, soil types and season of operation (II.A.2).
- Suitable location, size, and number of landings (II.A.6).
- Skidding operation minimizes compaction (II.C.1.b).
- Adequate drainage for landings (II.C.2.b).
- Scarify only to the extent necessary (II.D.4).
- Equipment operation on suitable slopes only (II.D.6).
- Cross streams at right angles if practical (III.B.1.a).
- Avoid unimproved stream crossings (III.B.2).
- Minimize stream channel disturbance (III.C.1).
- Minimum cover for culverts provided (III.C.5)
- Adequate storage and disposal for fuel, waste oil (V.A).

Logging contractors attended 31 out of the 44 audits. Team members felt it was beneficial for all if contractors attended.

Audit team members noticed a range of potential or actual water quality impacts that are not reflected in the results. Both grazing and mining impacts were observed at several audit sites. In some cases, road erosion problems were the result of other land uses.

Streamside Management Zones

The questionnaire used in the 1994 BMP audits to evaluate the application and implementation of requirements of the SMZ law and rules were dropped from the 1996 audits. The questionnaire was replaced with nine questions that were put into a rating form. These questions were taken from the SMZ/BMP's and the SMZ rules. The question format was the same as the 47 BMP questions with a 5-point rating scale. These questions did not constitute a DNRC enforcement action. Audit team members evaluated departures based on their best professional judgement.

Photo #8. Audit Team Evaluating SMZ.

Both the law and the rules were applicable to 42 of the 44 sites. The remaining two sites did not have stream channels that meet the definition of a stream contained in the law. Both the law and the rules were applicable to some phase of the harvest operation (road construction, harvest or slash disposal) on all of these 42 sites.

Harvest of trees within the SMZ occurred on 24 of the 44 sites. Four pre-approved alternative practices, as allowed under the rules and four DNRC approved site specific alternative practices were utilized on six of the sites evaluated.

A total of 29 departures from either the law or rules were noted on 18 of the 42 applicable sites. SMZ departures occurred on 83% of the applicable (NIP) sites, 40% of the applicable state sites, 33% of the applicable (FED) sites and 15% of the applicable (IND) sites (see Table 9) and Fig 3.

Table 9

SMZ Departures by Ownership Group

Ownership Group	Number of Sites Evaluated	Number of Sites With Departures	Total Number of Departures
Federal	12	4	6
Industrial	13	2	2
NIP	12	10	19
State	5	2	2
All Sites	42	18	29

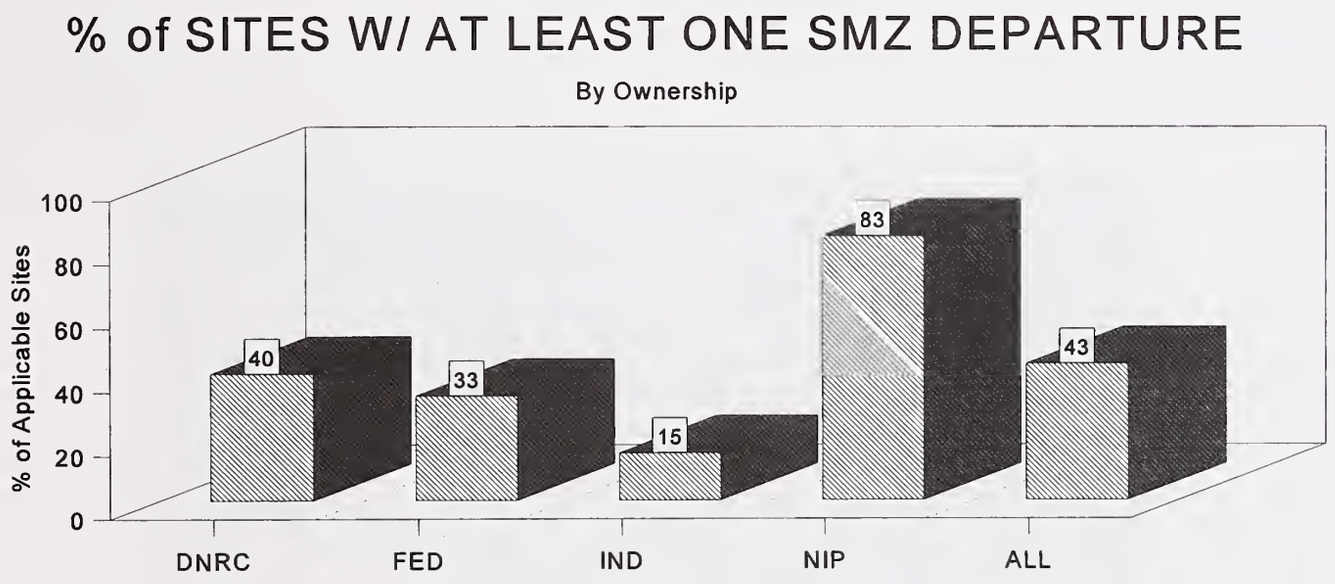


Figure 3

SMZ maintained/properly marked was the most common departure and occurred on 10 of the sites. Other practices with the most departures included clearcutting within the SMZ or failure to meet the retention tree requirements, sidecasting, broadcast burning, and logging slash deposited in streams (see Table 10). There were seven instances of equipment operation in the SMZ.

Table 10

SMZ Departures by Practice

Practice	# Departures
Broadcast Burning in SMZ	1
Equipment Operation in SMZ	7
Clearcutting/Retention Tree Requirements	3
Sidecasting into Stream	3
Slash Deposited into Stream	5
SMZ Maintained/Properly Marked	10
Total	29

Failure to mark or properly locate SMZ boundaries was observed on 10 sites. Improper SMZ delineations alone cannot be considered to be the sole cause of other departures at these sites. SMZ departures were noted on eight sites with properly located and marked SMZ boundaries. Three sites had no departures despite incorrect SMZ delineation. However, incorrect SMZ boundary delineation was judged to be a factor in contributing to 7 other departures at 6 sites.

Photo #9. Audit Team Member Measuring Slope for SMZ Boundary.

Although 29 departures were noted on 18 of the sites, most of the departures were minor in extent and produced no discernible impacts. For example, 6 of the 7 departures due to equipment operation in the SMZ consisted of one or two skid trails that were not located in immediate proximity to the stream. Audit teams determined that all but 8 of the SMZ departures were still effective in protecting water quality.

Results by Ownership Group

There are notable differences among the ownership groups in their application and effectiveness of all BMPs. Ratings for application of BMPs were as follows: State lands ranked highest among all ownership groups. Industrial lands ranked second; Federal (USFS) lands ranked 3rd, while non-industrial private ranked 4th in BMP application. In BMP effectiveness, the results for Industry (IND) and State lands were similar, and both ranked higher than the other ownership groups. Federal sites ranked third and NIP sites were ranked fourth in effectiveness. See Figure 2. Non-Industrial lands exhibited the highest average number of departures per site, however, this number is slightly lower than the 1994 average.

Comparison with Previous Audits

The 1996 audits were conducted in a manner directly comparable to the 1990, 1992 and 1994 audits. The same selection criteria and rating format were used. Most audit team members had participated in the 1990, 1992 and 1994 audits. Earlier audits, conducted in 1988 and 1989, were similar, but had differences in design and format. The most accurate comparison is among the 1990, 1992, 1994 and 1996 audits.

The 1996 audits show overall improvement in the application and effectiveness of BMPs when compared with the 1990, 1992 and 1994 results. See Table 11 for a comparison of the 1990, 1992, 1994 and 1996 results.

Table 11

Comparison of BMP Audit Results: 1994 vs. 1992 and 1990

	1996	1994	1992	1990
Application of Practices that Meet or Exceed BMP Requirements	92%	91%	87%	78%
Application of High Risk Practices that Meet or Exceed BMP Requirements	81%	79%	72%	53%
Number of Sites with At Least One Major Departure in BMP Application.	12 of 44 (27%)	17 of 46 (37%)	20 of 46 (43%)	27 of 44 (61%)
Average Number of Departures in BMP Application, Per Site.	3.0	3.9	5.6	9
Number of Practices Providing Adequate Protection	94%	93%	90%	80%
Number of High Risk Practices Providing Adequate Protection.	86%	83%	77%	58%
Number of Sites Having at Least One Major Temporary or Minor Prolonged Impact	15 of 44 (34%)	13 of 46 (28%)	17 of 46 (37%)	28 of 44 (64%)
Average Number of Impacts Per Site	2.3	3	4.6	8

Non-industrial private lands showed the most improvement over the last four cycles of audits. In 1990, NIP sites averaged 15 impacts per site. In 1992, NIP sites averaged 10 impacts per site. In 1994, NIP sites averaged 4 impacts per site. In 1996, NIP sites averaged less than 4 impacts per site. Minor/temporary impacts were reduced, and there were no gross neglect departures or major/prolonged impacts on NIP sites in 1996.

Federal sites showed increases in both application and effectiveness of practices rated in 1996. Federal lands also showed decreases in the percentage of sites with minor and major departures, as well as decreases in the percentages of major/temporary, minor/prolonged impacts. There were no gross neglect departures or major/prolonged impacts on Federal sites in 1996.

Industrial lands continued to show improvement. Seven of the Industrial sites had major/temporary or minor/prolonged impacts in 1996. In 1994, 21% of the sites had such impacts, while in 1992 the percentage was 31% and 69% in 1990. There were no gross neglect departures or major/prolonged impacts on Industrial sites in 1996.

State lands showed decreases in the percentage of practices rated with minor departures and minor/temporary impacts in 1996. State lands also showed increases in both application and effectiveness earning the highest ratings of 96% and 98% respectively. State lands were the only ownership group that had no major departures or major/temporary, minor/prolonged impacts in 1996.

Figure 4 displays BMP application results of 4 forestry BMP audits conducted in Montana.

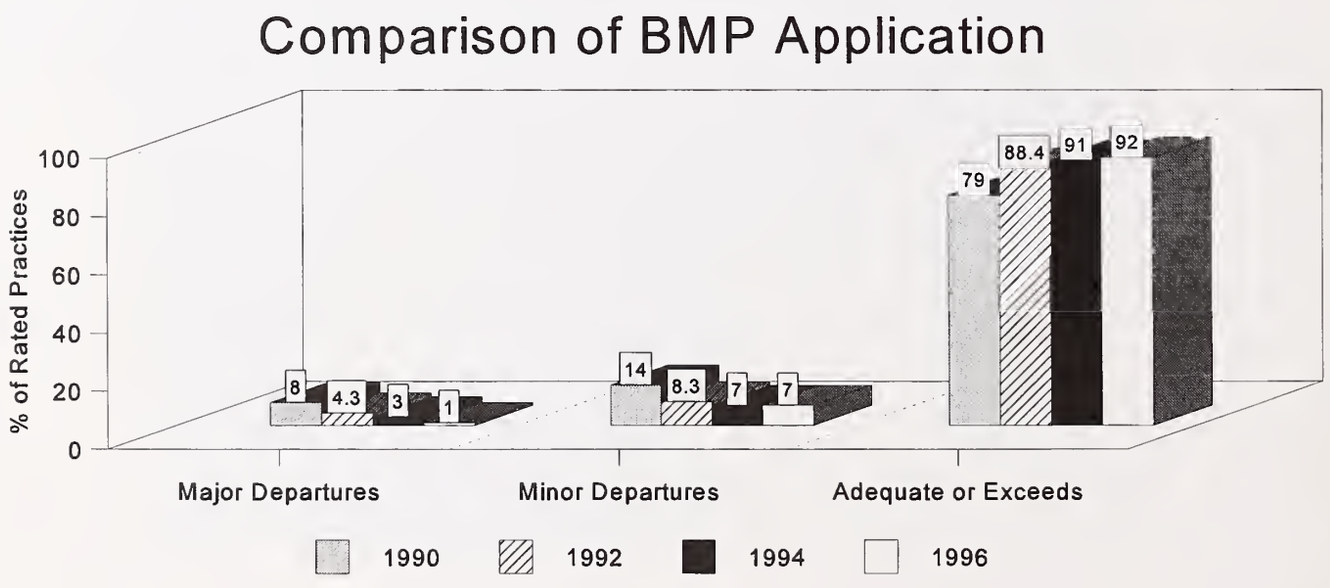


Figure 4 Major Departures Are Practices with an Application Rating <3.
Minor Departures Are Practices with an Application Rating of 3.
Adequate or Exceeds Are Practices with an Application Rating >3.

Figure 5 displays BMP effectiveness results of 4 forestry BMP audits conducted in Montana.

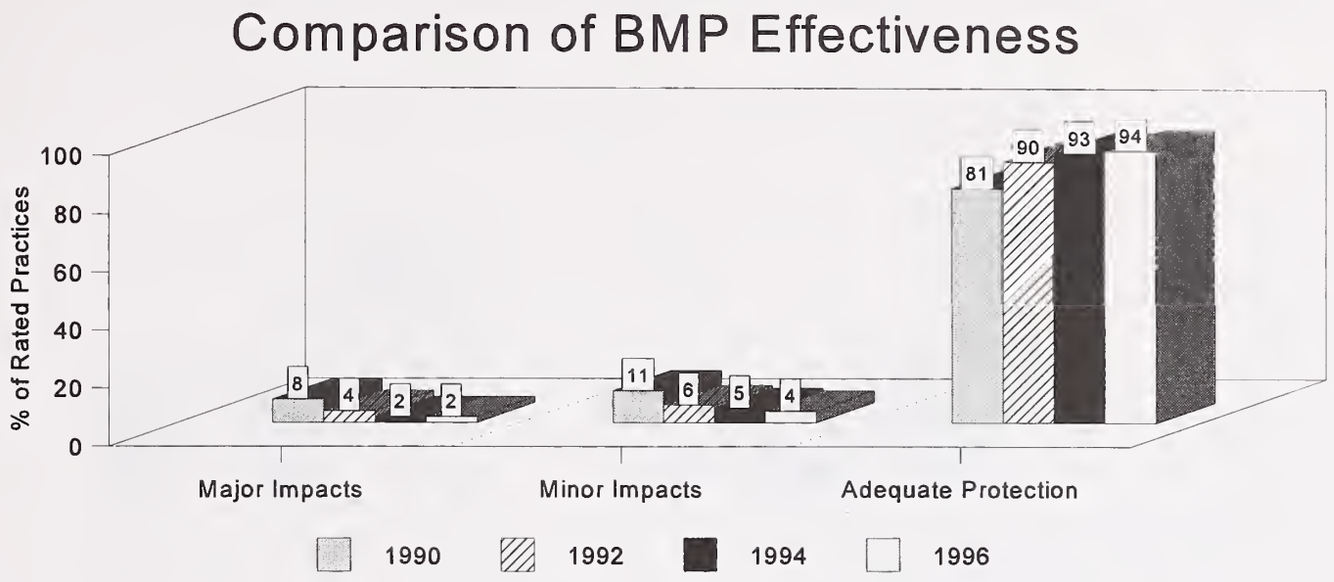


Figure 5 Major Impacts Are Practices with an Effectiveness Rating <3.
Minor Impacts Are Practices with an Effectiveness Rating of 3.
Adequate Protection Is a Practice with an Effectiveness Rating >3.

The 1996 audit ratings showed improvement over the 1990, 1992 and 1994 ratings when one looks at the percent of sites with major departures or impacts, as in Figure 6.

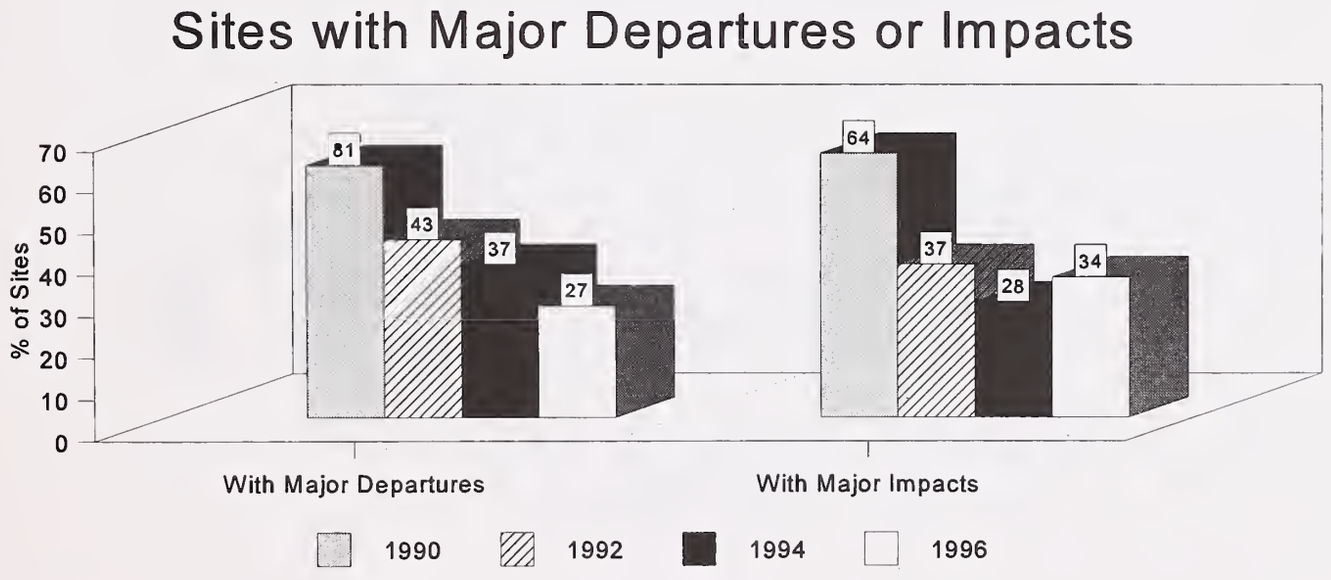


Figure 6. Major Departures Are Practices with an Application Rating of 1 or 2.
Major Impacts Are Practices with an Effectiveness Rating of 1 or 2.

The 1996 audits had fewer major departures and impacts per site than the 1990, 1992 and 1994 audits did. See Figures 7. & 8. Impacts/departures per site are expressed as a percentage of rated practices per site, in order to account for differences in the average number of rated practices per site between study years.

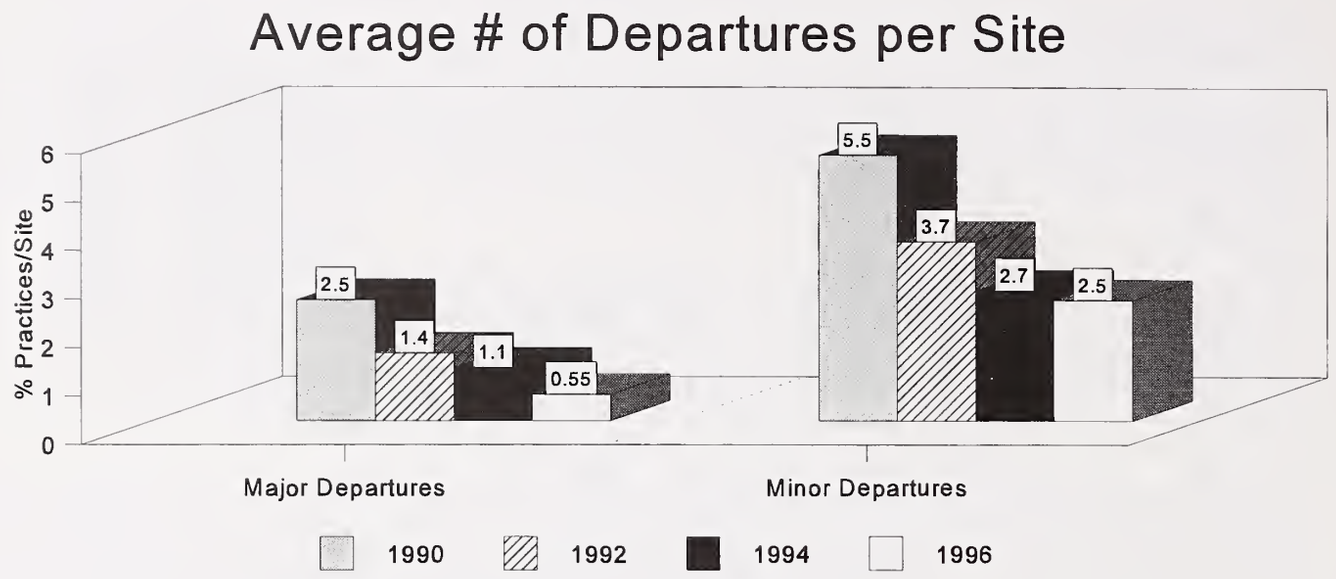


Figure 7. Major Departures are Practices with an Application Rating <3.
Minor Departures are Practices with an Application Rating of 3.

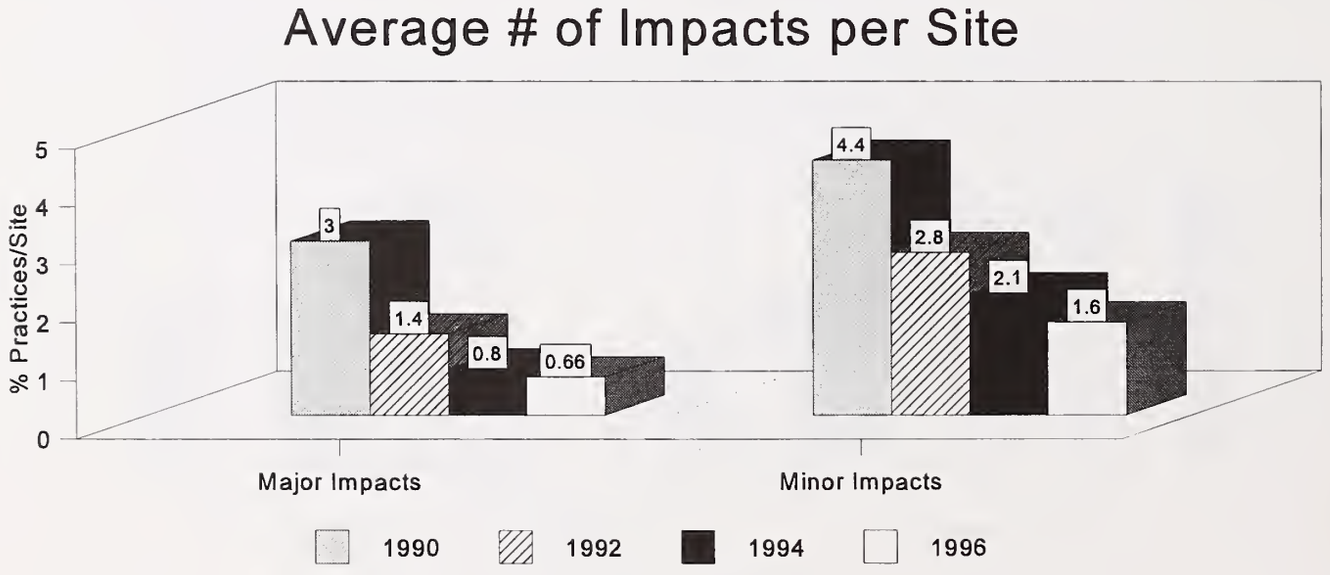


Figure 8. Major Impacts Are Practices with an Effectiveness Rating of <3.
Minor Impacts Are Practices with an Effectiveness Rating of 3.

RECOMMENDATIONS FROM AUDIT TEAM MEMBERS

- Continue the interdisciplinary forestry BMP audits. The audit process has been fundamental in educating and making people aware of BMP requirements. Conduct the audits every two years.

- Continue to evaluate implementation of the SMZ law and rules.

- Update the BMP audit process to include site selection processes, clarification and refinement of the BMP's and the audit form.

- Encourage the development of a mechanism to monitor the effectiveness of BMP's.

- Recognize the need to formally involve NIP landowners into the entire BMP audit process.

- Encourage all ownership groups to continue commitment, involvement and support in the audit process.

- Continue educating loggers, landowners, and foresters, concentrating on problem areas documented through BMP audits. Lack of adequate drainage on new and existing roads continues to be the primary impact to water quality. BMP education should emphasize the need for meeting road drainage BMPs.

- Actively encourage the site's owners and logging contractors to attend the audit. The Montana Logging Association and the Montana Wood Products Association will assist DNRC in notifying contractors. At a minimum, give contractors a copy of the audit results for their sites.

- The team leader should encourage the landowner and contractor and, if needed in the case of NIP lands, the DNRC Service Forester, to develop a remedy for problems noted. An audit team member will assist if necessary, especially to identify problems. Industry groups, such as MLA and MWPA may participate as needed.

- Continue funding volunteer audit team members.

- Institute a similar BMP audit process for other land uses, including mining, livestock grazing, agriculture and subdivision development.

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APPENDIX A

5/96

1996 BMP FIELD AUDITS

BMP AUDIT TEAM MEMBERS

EXPERTISE	AUDIT TEAM		
	NORTHWEST	**WEST CENTRAL**	**SOUTHWEST/EAST**
Fisheries	+ S. Rumsey, DFWP	+ D. Workman, DFWP*	+ J. Brammer, DFWP
	+(T. Weaver, DFWP)	+(C. Clancey, DFWP)	(D. Skarr DFWP)
	+(P. Van Eimeren, FS)		
Hydrology	+ S. Johnson, USFS	+ G. Frank, DNRC	+S. Tralles, DEQ\WQD*
	+(B. Sugden, PCT)	(P. Callahan, DNRC)	(B. Stuart, USFS)
	(J. Whittingham, BLM)		
Soils	+ J.Collins, DNRC	S. Barndt, USFS	+ H. Hunter, PVT
	(B. Basko, USFS)	+(T. Wiersum, NRCS)	+(B. Logar, NRCS)
Forestry	+ R. Hudson, PVT*	+ D. Wick, PCT	+ G. Sanders, PML
	+(L. Coryell, USFS)	+(P. Davis, PCT)	+(S. Flynn, LP)
Eng./Roads	+ V. Anderson, PCT	+(Jim Saubier, USFS)	+ J. Marshik, USFS
	+(F. McCubbins, STZ)	+(E. Applekamp, USFS)	+(S. Anderson, PVT)
Conservation	+ Dan Paschke, TU	+ B. Benson, CFC	+ P. Hackley, EIC
	+(R. Ash, Audub.)	(M Roy, NWF)	+(C. Jones, EIC)

Legend:

REDLINE Denotes Team Leader.

( ) Denotes Alternate.

+ Denotes Prior BMP Audit Team Experience.

* Denotes Alternate Team Leader

APPENDIX B

1996 BMP FIELD AUDITS
RISK RATING GUIDE

MONTANA "RISK" MATRIX (3/91)

TYPE		CLEAR-CUT				PARTIAL CUT				SITE PREP			ROADS	
SLOPE	SOIL EROD.	TERQAUCIKPED	RSUKBIBDER	PSAURSTPIAL	FSUULLSLP	TERQUACIKPED	RSUKBIBDER	PSAURSTPIAL	FSUULSLP	MPACHILEINE/SCAR	BBRUDRNCAST	OTHER	PERM	TEMP
0-5%	H	2	2	2	1	2**	2**	1	1	2	1	1	2**	3
	M	2	1	1	1**	2	1**	1	1	2**	1	1	1	1
	L	1	1	1	1	1	1	1	1	2	1	1	1	1
5-20%	H	4	3	2	1	4*	3	2	1	4	2	1	3	4
	M	3	2	1	1	3*	2	1	1	3	2	1	2	3
	L	2	2	1	1	2*	2*	1	1	2	1	1	2	2
20-40%	H	5	5	4*	2	5*	5*	3**	1	5	3**	1	4	5
	M	4*	4	3	1	3	3	2	1	4	3	1	3	4*
	L	3*	2	2	1	2	2	2	1	3	2	1	3*	3
>40%	H	5	5	4	2	5	5	4	2	5	4	1	5	5
	M	5	5	4	2*	5	5	3	1	5	4	1	5	5
	L	4	4	3	1	4	4	2	1	4	3*	1	4	4

(* Indicates Mean Value Used, ** Final Group Consensus Adjustment for Internal Consistency)

MONTANA EROSION-IMPACT MATRIX

From: "Management Guidelines for Riparian Forests" by Robert Pfister and Kim Sherwood. Flathead Basin Forest Practices Water Quality and Fisheries Cooperative Program.

LEGEND
1 = LOW RISK 2-3 = MODERATE RISK 4-5 = HIGH RISK

SOIL ERODIBILITY

HIGH ERODIBILITY
- GRANITICS
- ALLUVIUM
- LACUSTRINE

MODERATE ERODIBILITY
- SCHIST
- SOFT/HARD SEDIMENTS
- BASIC IGNEOUS

LOW ERODIBILITY
- ARGILLITE/QUARTZITE
- METAMORPHIC (BELT)

HIGH RISK DUE TO RIPARIAN HARVEST

"HIGH" risk will be assigned to sales with logging in riparian zones along streams. Riparian zones are located between aquatic and terrestrial environments are identified by distinct vegetation that requires or tolerates free or unbound water. This includes but is not limited to the following habitat types: ABLA/CACA, (all phases), ABLA/APHO, PICEA/EQAR, THPL/OPHO.

APPENDIX C

DS-49

BMP FIELD AUDITS
SITE INFORMATION

Site Number: _____ Meets Selection Criteria: _____
High Hazard: _____

Site Name: _____

Owner: _____

Legal Description: _____ County: _____

Primary Drainage: _____ Month/Year Harvested: _____

Stream Within 200 Ft.? Y / N Name: _____ Bankfull Width: _____

Unit Size: _____ Volume Removed: _____

Road Construction: _____ Length: _____

Road Reconstruction: _____ Length: _____

Slash Disposal Complete: _____ Method: _____

Logging Method: _____

Slope: 0-5% ____; 5-20% ____; 20-40% ____; 40%+ ____

Parent Material: _____

Soil Erodibility: High ___ Medium ___ Low ___

Harvest in Riparian: Y / N

Stream Class:

Comments:

RATING GUIDE

APPLICATION
5--OPERATION EXCEEDS REQUIREMENTS OF BMP
4--OPERATION MEETS REQUIREMENTS OF BMP
3--MINOR DEPARTURE FROM BMP
2--MAJOR DEPARTURE FROM BMP
1--GROSS NEGLECT OF BMP

EFFECTIVENESS
5--IMPROVED PROTECTION OF SOIL AND WATER RESOURCES OVER PRE-PROJECT CONDITION
4--ADEQUATE PROTECTION OF SOIL AND WATER RESOURCES
3--MINOR AND TEMPORARY IMPACTS ON SOIL & WATER RESOURCES
2--MAJOR AND TEMPORARY OR MINOR AND PROLONGED IMPACTS ON SOIL AND WATER RESOURCES.
1--MAJOR AND PROLONGED IMPACTS ON SOIL AND WATER RESOURCES.

DEFINITIONS (BY EXAMPLE):
ADEQUATE--SMALL AMOUNT OF MATERIAL ERODED; MATERIAL DOES NOT REACH DRAWS, CHANNELS, OR FLOODPLAIN.
MINOR--EROSION AND DELIVERY OF MATERIAL TO DRAWS BUT NOT STREAM.
MAJOR--EROSION AND SUBSEQUENT DELIVERY OF SEDIMENT TO STREAM OR ANNUAL FLOODPLAIN.
TEMPORARY--IMPACTS LASTING ONE YEAR OR LESS; NO MORE THAN ONE RUNOFF SEASON.
PROLONGED--IMPACTS LASTING MORE THAN ONE YEAR.

NR--NOT REVIEWED NA--NOT APPLICABLE

FIELD AUDIT

Date: _____

Team Leader/Recorder: _____

Team Members: _____

_____

Observers Present:

MONTANA FOREST PRACTICES REVIEW WORKSHEET

BMPs Applicable to:
+ New Road Construction
* Existing Roads
▸ Reconstruction

	RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N) APPLICATION	EFFECTIVENESS		COMMENTS
	SECTION I--ROADS				
	ROAD PLANNING & LOCATION SECTION I.A.				
▸+	1a. MINIMIZE NUMBER OF ROADS NECESSARY.				
*	1b. USE EXISTING ROADS UNLESS AGGRAVATE EROSION.				
+	3. AVOID LONG, SUSTAINED, STEEP ROAD GRADES.				
+	4. LOCATIONS AVOID HIGH HAZARD SITES (I.E., WET AREAS AND UNSTABLE SLOPES).				
+	5. ADEQUATE SMZ BETWEEN ROAD AND STREAM CHANNELS WHERE ROADS ARE LOCATED ALONG STREAMS.				
+	6a. MINIMIZE NUMBER OF STREAM CROSSINGS. NUMBER _____.				
+	6b. CHOOSE STABLE STREAM CROSSING SITES.				
	ROAD DESIGN SECTION I.B.				
▸+	2. DESIGN ROADS TO MINIMUM STANDARD NECESSARY TO ACCOMMODATE ANTICIPATED USES.				
+	4. VARY ROAD GRADE TO REDUCE CONCENTRATED DRAINAGE.				
+▸	5. PROPER SIZING FOR CROSSING STRUCTURES.				
	DRAINAGE FROM ROAD SURFACE SECTION I.C.				
+▸*	1. PROVIDE ADEQUATE ROAD SURFACE DRAINAGE FOR ALL ROADS.				

I.D. _____ + New Road Construction; * Existing Roads; ▸ Reconstruction

	RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
+▸	2. SKEW DITCH RELIEF CULVERTS.				
+▸*	4. PROVIDE ENERGY DISSIPATORS AT DRAINAGE STRUCTURE OUTLETS WHERE NEEDED.				
+▸*	6. ROUTE ROAD DRAINAGE THROUGH ADEQUATE FILTRATION ZONES BEFORE ENTERING A STREAM.				
	CONSTRUCTION/RECONSTRUCTION SECTION I.D.				
+▸	2. STABILIZE ERODIBLE SOILS (I.E., SEEDING, BENCHING, MULCHING).				
+▸	3. SLASH FILTER WINDROWS INSTALLED.				
+▸	5. CUT AND FILL SLOPES AT STABLE ANGLES. SLOPE RATIO: _____.				
+▸	6. AVOID INCORPORATING WOODY DEBRIS IN ROAD FILL.				
+▸	8. EXCESS MATERIALS (WASTE) PLACED IN LOCATIONS THAT AVOID ENTERING STREAM.				
+▸	9. SEDIMENT FROM BORROW PITS AND GRAVEL PITS MINIMIZED.				
▸	10. RECONSTRUCT ONLY TO THE EXTENT NECESSARY TO PROVIDE ADEQUATE DRAINAGE AND SAFETY.				
	ROAD MAINTENANCE SECTION I.E.				
+▸*	1. GRADE ROADS IF NECESSARY TO MAINTAIN DRAINAGE.				
+▸*	2. MAINTAIN EROSION CONTROL FEATURES (DIPS, DITCHES AND CULVERTS FUNCTIONAL).				
*	3. AVOID CUTTING THE TOE OF CUT SLOPES.				
+▸*	6. AVOID USE OF ROADS DURING WET PERIODS AND SPRING BREAKUP.				
+▸*	8. ABANDONED ROADS IN CONDITION TO PROVIDE ADEQUATE DRAINAGE WITHOUT FURTHER MAINTENANCE.				

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N) APPLICATION	EFFECTIVENESS		COMMENTS
SECTION II--TIMBER HARVESTING				
HARVEST DESIGN SECTION II.A.				
2. SUITABLE LOGGING SYSTEM FOR TOPOGRAPHY, SOIL TYPE AND SEASON OF OPERATION.				
5. DESIGN AND LOCATE SKID TRAILS TO AVOID CONCENTRATING RUNOFF.				
6. SUITABLE LOCATION, SIZE, AND NUMBER OF LANDINGS.				
OTHER HARVESTING ACTIVITIES SECTION II.C.				
1a. SKIDDING OPERATION MINIMIZES SOIL COMPACTION AND DISPLACEMENT.				
1b. AVOID TRACTOR SKIDDING ON UNSTABLE SLOPES AND SLOPES THAT EXCEED 40% UNLESS NOT CAUSING EXCESSIVE EROSION.				
2a. ADEQUATE DRAINAGE FOR TEMPORARY ROADS, SKID TRAILS AND FIRE LINES.				
2b. ADEQUATE DRAINAGE FOR LANDINGS.				
SLASH TREATMENT AND SITE PREPARATION SECTION II.D.				
2. BRUSH BLADES USED ON DOZERS.				
4. SCARIFY ONLY TO THE EXTENT NECESSARY TO MEET REFORESTATION OBJECTIVE.				
5. ACTIVITIES LIMITED TO FROZEN OR DRY CONDITIONS TO MINIMIZE SOIL COMPACTION AND DISPLACEMENT.				
6. EQUIPMENT OPERATIONS ON SUITABLE SLOPES ONLY.				
9. LIMIT WATER QUALITY IMPACT OF PRESCRIBED FIRE.				

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
SECTION III--STREAM CROSSINGS				
LEGAL REQUIREMENTS SECTION III.A.				
▸+ 1. PROPER PERMITS FOR STREAM CROSSINGS.				
DESIGN CONSIDERATIONS SECTION III.B.				
▸+ 1a. CROSS STREAMS AT RIGHT ANGLES, IF PRACTICAL.				
▸+ 1b. DIRECT ROAD DRAINAGE AWAY FROM STREAM CROSSING SITE.				
▸+ 2. AVOID UNIMPROVED STREAM CROSSINGS.				
INSTALLATION OF STREAM CROSSINGS SECTION III.C.				
▸+ 1. MINIMIZE STREAM CHANNEL DISTURBANCE.				
▸+ 2. CULVERTS CONFORM TO NATURAL STREAMBED AND SLOPE.				
▸+ 3. PREVENT EROSION OF CULVERT AND BRIDGE FILLS (I.E., ARMOR INLET AND OUTLET.				
▸+ 5. MINIMUM COVER FOR CULVERTS PROVIDED.				
SECTION V--HAZARDOUS SUBSTANCES				
GENERAL SECTION V.A.				
2. ADEQUATE STORAGE AND DISPOSAL FOR FUEL, SHOP DEBRIS, AND WASTE OIL.				

WERE ANY CWE ASSESSMENTS OR WATERSHED ANALYSIS INCLUDED IN THE TIMBER HARVEST PLANNING? IF YES, WHAT TYPE AND LEVEL OF ANALYSIS WAS CARRIED OUT (I.E., MONITORING, SCREENING, CWE INDICES, INTERDISCIPLINARY TEAMS, ASSESSMENTS OF CHANGING GEOMORPHIC PROCESSES, A COMBINATION OF TWO OR MORE.)	RESPONSE:

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
SECTION II--TIMBER HARVESTING				
HARVEST DESIGN SECTION II.A.				
2. SUITABLE LOGGING SYSTEM FOR TOPOGRAPHY, SOIL TYPE AND SEASON OF OPERATION.				
5. DESIGN AND LOCATE SKID TRAILS TO AVOID CONCENTRATING RUNOFF.				
6. SUITABLE LOCATION, SIZE, AND NUMBER OF LANDINGS.				
OTHER HARVESTING ACTIVITIES SECTION II.C.				
1a. SKIDDING OPERATION MINIMIZES SOIL COMPACTION AND DISPLACEMENT.				
1b. AVOID TRACTOR SKIDDING ON UNSTABLE SLOPES AND SLOPES THAT EXCEED 40% UNLESS NOT CAUSING EXCESSIVE EROSION.				
2a. ADEQUATE DRAINAGE FOR TEMPORARY ROADS, SKID TRAILS AND FIRE LINES.				
2b. ADEQUATE DRAINAGE FOR LANDINGS.				
SLASH TREATMENT AND SITE PREPARATION SECTION II.D.				
2. BRUSH BLADES USED ON DOZERS.				
4. SCARIFY ONLY TO THE EXTENT NECESSARY TO MEET REFORESTATION OBJECTIVE.				
5. ACTIVITIES LIMITED TO FROZEN OR DRY CONDITIONS TO MINIMIZE SOIL COMPACTION AND DISPLACEMENT.				
6. EQUIPMENT OPERATIONS ON SUITABLE SLOPES ONLY.				
9. LIMIT WATER QUALITY IMPACT OF PRESCRIBED FIRE.				

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
SECTION III--STREAM CROSSINGS				
LEGAL REQUIREMENTS SECTION III.A.				
▸+ 1. PROPER PERMITS FOR STREAM CROSSINGS.				
DESIGN CONSIDERATIONS SECTION III.B.				
▸+ 1a. CROSS STREAMS AT RIGHT ANGLES, IF PRACTICAL.				
▸+ 1b. DIRECT ROAD DRAINAGE AWAY FROM STREAM CROSSING SITE.				
▸+ 2. AVOID UNIMPROVED STREAM CROSSINGS.				
INSTALLATION OF STREAM CROSSINGS SECTION III.C.				
▸+ 1. MINIMIZE STREAM CHANNEL DISTURBANCE.				
▸+ 2. CULVERTS CONFORM TO NATURAL STREAMBED AND SLOPE.				
▸+ 3. PREVENT EROSION OF CULVERT AND BRIDGE FILLS (I.E., ARMOR INLET AND OUTLET.				
▸+ 5. MINIMUM COVER FOR CULVERTS PROVIDED.				
SECTION V--HAZARDOUS SUBSTANCES				
GENERAL SECTION V.A.				
2. ADEQUATE STORAGE AND DISPOSAL FOR FUEL, SHOP DEBRIS, AND WASTE OIL.				

WERE ANY CWE ASSESSMENTS OR WATERSHED ANALYSIS INCLUDED IN THE TIMBER HARVEST PLANNING? IF YES, WHAT TYPE AND LEVEL OF ANALYSIS WAS CARRIED OUT (I.E., MONITORING, SCREENING, CWE INDICES, INTERDISCIPLINARY TEAMS, ASSESSMENTS OF CHANGING GEOMORPHIC PROCESSES, A COMBINATION OF TWO OR MORE.)	RESPONSE:

I.D. _____ + New Road Construction; * Existing Roads; ▸ Reconstruction

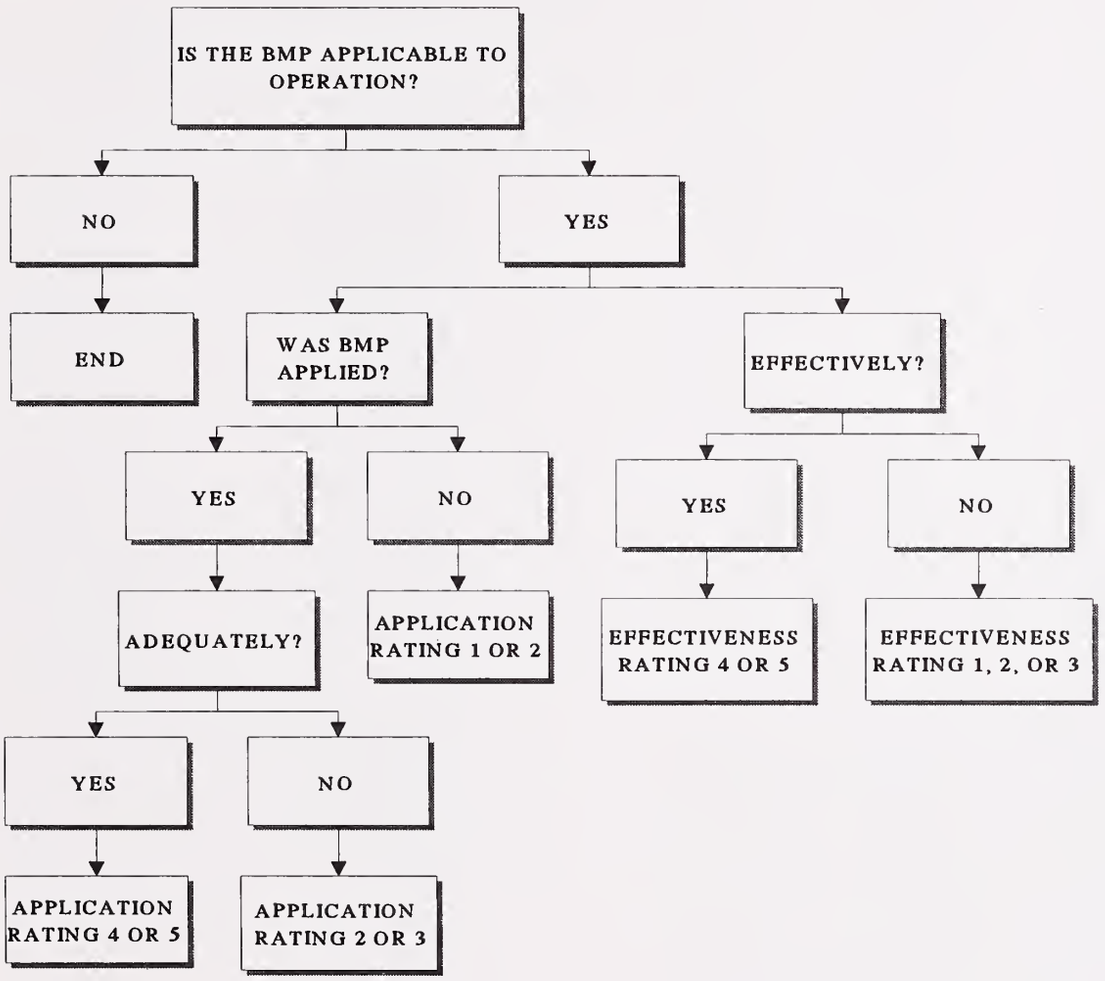
STREAMSIDE MANAGEMENT ZONE SITE INFORMATION	
ARE SMZ RULES APPLICABLE? (EFF. 3/15/93)	Y / N
WERE ANY PRE-APPROVED ALTERNATIVE PRACTICES UTILIZED? (* DENOTES PRACTICES THAT APPLY.)	Y / N (LIST APPLIED PRACTICES)
WERE ANY DNRC-APPROVED SITE-SPECIFIC ALTERNATIVE PRACTICES IMPLEMENTED IN THE HARVEST ACTIVITIES? (** DENOTES PRACTICES THAT APPLY.)	Y / N (LIST APPLIED PRACTICES)

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
1. ADEQUATE SMZ WIDTH MAINTAINED AND PROPERLY MARKED? AVG. WIDTH _____.				
2. EXCLUSION OF BROADCAST BURNING IN SMZ.**				
3. SMZ RETENTION TREE REQUIREMENTS MET. (# OF TREES, REPRESENTATIVE OF PRE-HARVEST STAND, FAVOR BANK-EDGE AND LEANING TREES, SHRUBS AND SUBMERCHANTABLE)**				
4. EXCLUSION OF EQUIPMENT OPERATION IN SMZ EXCEPT ON ESTABLISHED ROADS.*				
5. EXCLUDE CONSTRUCTION OF ROADS IN THE SMZ EXCEPT WHEN NECESSARY TO CROSS A STREAM OR WETLAND.**				
6. EXCLUSION OF ROAD FILL MATERIAL DEPOSITED IN SMZ EXCEPT AS NEEDED TO CONSTRUCT CROSSINGS.				
7. EXCLUSION OF SIDE-CASTING OF ROAD MATERIAL INTO A STREAM, LAKE, WETLAND OR OTHER BODY OF WATER DURING ROAD MAINTENANCE.				
8. EXCLUSION OF SLASH IN STREAMS, LAKES OR OTHER BODIES OF WATER.**				
9. EXCLUDE THE HANDLING, STORAGE, APPLICATION OR DISPOSAL OF HAZARDOUS OR TOXIC MATERIALS IN THE SMZ IN A MANNER THAT POLLUTES OR CAUSES DAMAGE OR INJURY.				

ADDITIONAL COMMENTS:

APPENDIX D

RATIONALE FOR THE RATING SYSTEM
POST HARVEST EVALUATION



APPENDIX E

1996 BMP FIELD AUDITS
SITES PICKED FOR AUDITS
BY OWNERSHIP GROUP

Number	Sale Name	Location	County	Owner	Team	
DNRC-1	Six Mile	S12 T15N-R22W	Msla	State	WC	
DNRC-2	Tom Miner	S16 T08S-R06E	Gallatin	State	SW	
DNRC-3	Werner/Taylor	S30 T33N-R22W	Flthd	State	NW	
DNRC-4	Deer Park	S36 T15N-R11W	Powell	State	WC	
DNRC-5	Clear Creek	S36 T25N-R25W	Flthd	State	SW	
FED-1	Upper Cabin	S11 T07N-R04E	Brdwtr	USFS	SW	
FED-2	Thompson View	S16 T26N-R26W	Flthd	USFS	NW	
FED-3	Deep Gilman	S12 T13N-R22W	Msla	USFS	WC	
FED-4	Truman Emmons	S12 T26N-R22W	Flthd	USFS	NW	
FED-5	Saw Mill	S24 T06N-R14W	Granite	USFS	SW	
FED-6	Deadhorse	S03 T10N-R10E	Meagher	USFS	SW	
FED-7	Slate Point	S01 T02S-R22W	Ravalli	USFS	WC	
FED-8	Tangled Again	S22 T31N-R27W	Lincoln	USFS	NW	
FED-9	Fourth Cyclone	S07 T34N-R33W	Lincoln	USFS	NW	
FED-10	31 Special	S05 T34N-R33W	Lincoln	USFS	NW	
FED-11	Lewis Gulch	S09 T04S-R13E	Swtgrass	USFS	SW	
FED-12	Upper Mantrap	S29 T25N-R28W	Sanders	USFS	WC	
IND-1	Porter Creek	S21 T27N-R23W	Flthd	PCT	NW	
IND-2	Ashley Mtn.	S17 T29N-R24W	Flthd	PCT	NW	
IND-3	Bear 21	S21 T04S-R05E	Gallatin	BSL	SW	
IND-4	Action Jackson	S25 T01S-R07E	Gallatin	BSL	SW	
IND-5	Mill Tevis	S09 T11N-R21W	Msla	PCT	WC	
IND-6	Olney Face	S27 T33N-R23W	Flthd	PCT	NW	
IND-7	Graves Thin	S01 T12N-R23W	Msla	PCT	WC	
IND-8	Pearson Green	S09 T14N-R13W	Powell	PCT	WC	
IND-9	Walters #1	S01 T27N-R25W	Flthd	SLL	WC	
IND-10	C&J Kids	S27 T14N-R13W	Powell	PCT	WC	
IND-11	33 Owls	S33 T26N-R29W	Lincoln	PCT	NW	
IND-12	Carrigan Camp	S09 T32N-R31W	Lincoln	PCT	NW	
IND-13	Kelsey Creek	S32 T31N-R26W	Lincoln	PCT	NW	
IND-14	Deerhorn	S31 T23N-R27W	Sanders	PCT	WC	
NIP-1	Bald Butte	S16 T11N-R06W	L&C	NIP	SW	
NIP-2	Latham Gulch	S33 T10N-R06W	Powell	NIP	SW	
NIP-3	Rock Creek	S05 T04N-R15W	Granite	NIP	SW	
NIP-4	Wolf Mtn.	S14 T06S-R37E	Big Horn	NIP	SW	
NIP-5	Alaska Bench	S27 T13N-R20E	Fergus	NIP	SW	
NIP-6	Goodman Creek	S12 T03N-R43E	Rosebud	NIP	SW	
NIP-7	Mud Gulch	S14 T14N-R03E	Meagher	NIP	SW	
NIP-8	Sleeping Child	S01 T03N-R19W	Ravalli	NIP	WC	
NIP-9	Blackfoot	S25 T14N-R10W	Powell	NIP	WC	
NIP-10	Stillwater	S29 T32N-R23W	Flthd	NIP	NW	
NIP-11	Lion Mtn.	S22 T31N-R22W	Flthd	NIP	NW	
NIP-12	Iron Creek	S06 T30N-R33W	Lincoln	NIP	NW	
NIP-13	Swamp Creek	S13 T25N-R32W	Sanders	NIP	WC	Dropped
NIP-14	McKay Creek	S34 T26N-R32W	Sanders	NIP	WC	
NIP-15	Halfbreed	S07 T07N-R26E	Musselshl	NIP	SW	Dropped

APPENDIX F

1996 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
ROAD PLANNING													
Minimize # of Roads I.A.1a	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
	FED	0	0	0	11	0	1	0	0	0	11	0	1
	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	0	11	0	2	0	0	0	11	0	2
	Total:	0	0	0	41	0	3	0	0	0	41	0	3
Use Existing Roads I.A.1b	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
	FED	0	0	0	11	0	1	0	0	0	11	0	1
	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	0	0	43	0	1	0	0	0	43	0	1
Avoid Long, Steep Grades I.A.3	DNRC	0	0	0	3	0	2	0	0	0	3	0	2
	FED	0	0	0	10	0	2	0	0	0	10	0	2
	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	0	10	0	3	0	0	0	10	0	3
	Total:	0	0	0	37	0	7	0	0	0	37	0	7
Avoid High Hazard Areas I.A.4	DNRC	0	0	0	2	1	2	0	0	0	2	1	2
	FED	0	0	0	10	0	2	0	0	0	10	0	2
	IND	0	0	0	13	0	1	0	0	0	13	0	1
	NIP	0	0	0	11	0	2	0	0	0	11	0	2
	Total:	0	0	0	36	1	7	0	0	0	36	1	7
Adequate SMZ Planned I.A.5	DNRC	0	0	0	3	0	2	0	0	0	3	0	2
	FED	0	0	0	8	0	4	0	0	0	8	0	4
	IND	0	0	0	12	0	2	0	0	0	12	0	2
	NIP	0	0	0	10	0	3	0	0	0	10	0	3
	Total:	0	0	0	33	0	11	0	0	0	33	0	11
Minimize # of Stream X'ings I.A.6a	DNRC	0	0	0	3	0	2	0	0	0	3	0	2
	FED	0	0	0	8	0	4	0	0	0	8	0	4
	IND	0	0	0	12	0	2	0	0	0	12	0	2
	NIP	0	0	0	7	0	6	0	0	0	7	0	6
	Total:	0	0	0	30	0	14	0	0	0	30	0	14

1996 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Choose	DNRC	0	0	0	3	0	2	0	0	0	3	0	2
Stable Stream	FED	0	0	0	7	0	5	0	0	0	7	0	5
Crossing Sites	IND	0	0	0	10	0	4	0	0	0	10	0	4
I.A.6b	NIP	0	0	0	7	0	6	0	0	0	7	0	6
	Total:	0	0	0	27	0	17	0	0	0	27	0	17
ROAD DESIGN													
Minimum Design	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Standards	FED	0	0	0	11	0	1	0	0	0	11	0	1
I.B.2	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	2	9	0	2	0	0	1	10	0	2
	Total:	0	0	2	39	0	3	0	0	1	40	0	3
Vary Grade	DNRC	0	0	0	3	0	2	0	0	0	3	0	2
for Drainage	FED	0	0	0	8	0	4	0	0	0	8	0	4
I.B.4	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	1	10	0	2	0	0	1	10	0	2
	Total:	0	0	1	35	0	8	0	0	1	35	0	8
Crossings	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Properly Sized	FED	0	0	0	7	0	5	0	0	0	7	0	5
I.B.5	IND	0	0	0	10	0	4	0	0	0	10	0	4
	NIP	0	1	1	5	0	6	0	1	1	15	0	6
	Total:	0	1	1	27	0	15	0	1	1	27	0	15
ROAD DRAINAGE													
Adequate Sur-	DNRC	0	0	2	3	0	0	0	0	1	4	0	0
face Drainage	FED	0	1	2	9	0	0	0	2	1	9	0	0
I.C.1	IND	0	0	4	10	0	0	0	0	2	12	0	0
	NIP	0	0	7	6	0	0	0	0	6	7	0	0
	Total:	0	1	15	28	0	0	0	2	10	32	0	0
Skew Relief	DNRC	0	0	0	3	0	2	0	0	0	3	0	2
Culverts	FED	0	0	2	7	0	3	0	0	1	8	0	3
I.C.2	IND	0	0	0	8	0	6	0	0	0	8	0	6
	NIP	0	0	3	0	0	10	0	0	2	1	0	10
	Total:	0	0	5	18	0	21	0	0	3	20	0	21

1996 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Energy Dissip.	DNRC	0	0	0	4	0	1	0	0	0	4	0	1
at CMP Outlets	FED	0	0	2	9	0	1	0	0	1	10	0	1
I.C.4	IND	0	0	0	10	0	4	0	0	0	10	0	4
	NIP	0	0	2	7	0	4	0	1	0	8	0	4
	Total:	0	0	4	30	0	10	0	1	1	32	0	10
Route Drainage	DNRC	0	0	1	4	0	0	0	0	1	4	0	0
Through SMZ	FED	0	1	2	9	0	0	0	2	1	9	0	0
I.C.6	IND	0	0	2	11	0	1	0	0	2	11	0	1
	NIP	0	1	1	8	0	3	0	2	0	8	0	3
	Total:	0	2	6	32	0	4	0	4	4	32	0	4
ROAD CONSTRUCTION													
Stabilize	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Erodible Soils	FED	0	0	0	11	0	1	0	0	1	10	0	1
I.D.2	IND	0	0	1	13	0	0	0	0	1	13	0	0
	NIP	0	1	2	8	0	2	0	0	3	8	0	2
	Total:	0	1	3	37	0	3	0	0	5	36	0	3
Slash Filter	DNRC	0	0	0	3	0	2	0	0	0	3	0	2
Windrows	FED	0	0	2	6	0	4	0	0	1	7	0	4
I.D.3	IND	0	1	2	8	0	3	0	1	3	7	0	3
	NIP	0	2	5	0	0	6	0	4	3	0	0	6
	Total:	0	3	9	17	0	15	0	5	7	17	0	15
Slopes at	DNRC	0	0	1	4	0	0	0	0	1	4	0	0
Stable Angle	FED	0	1	0	9	0	2	0	1	0	9	0	2
I.D.5	IND	0	0	3	11	0	0	0	0	0	14	0	0
	NIP	0	2	3	6	0	2	0	2	2	7	0	2
	Total:	0	3	7	30	0	4	0	3	3	34	0	4
Clear Veget.	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Before Const.	FED	0	0	0	9	0	3	0	0	0	9	0	3
I.D.6	IND	0	0	2	12	0	0	0	0	1	13	0	0
	NIP	0	0	2	9	0	2	0	0	2	9	0	2
	Total:	0	0	4	35	0	5	0	0	3	36	0	5

1996 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Overburden	DNRC	0	0	0	3	0	2	0	0	0	3	0	2
Placement	FED	0	0	1	7	0	4	0	1	0	7	0	4
I.D.8	IND	0	0	1	10	0	3	0	0	1	10	0	3
	NIP	0	1	0	4	0	8	0	1	0	4	0	8
	Total:	0	1	2	24	0	17	0	2	1	24	0	17
Sediment From	DNRC	0	0	0	1	0	4	0	0	0	1	0	4
Borrow Pits	FED	0	0	0	1	0	11	0	0	0	1	0	11
I.D.9	IND	0	0	0	1	0	13	0	0	0	1	0	13
	NIP	0	1	0	3	0	9	0	0	1	3	0	9
	Total:	0	1	0	6	0	37	0	0	1	6	0	37
Minimize	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Reconstruction	FED	0	0	0	6	1	5	0	0	0	6	1	5
I.D.10	IND	0	0	0	10	0	4	0	0	0	10	0	4
	NIP	0	0	0	7	0	6	0	0	0	7	0	6
	Total:	0	0	0	28	1	15	0	0	0	28	1	15
ROAD MAINTENANCE													
Grade Roads	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
for Drainage	FED	0	0	1	11	0	0	0	0	1	11	0	0
I.E.1	IND	0	0	1	13	0	0	0	0	1	13	0	0
	NIP	0	0	1	12	0	0	0	0	0	13	0	0
	Total:	0	0	3	41	0	0	0	0	2	42	0	0
Erosion Control	DNRC	0	0	2	3	0	0	0	0	2	3	0	0
Functional	FED	0	0	2	10	0	0	0	0	2	10	0	0
I.E.2	IND	0	0	2	12	0	0	0	0	0	14	0	0
	NIP	0	0	4	7	0	2	0	0	2	9	0	2
	Total:	0	0	10	32	0	2	0	0	6	36	0	2
Avoid Cutting	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Slope Toe	FED	0	0	1	11	0	0	0	0	0	12	0	0
I.E.3	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	1	11	0	1	0	0	1	11	0	1
	Total:	0	0	2	41	0	1	0	0	1	42	0	1

1996 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Restrict Use	DNRC	0	0	1	4	0	0	0	0	0	5	0	0
When Wet	FED	0	0	0	12	0	0	0	0	0	12	0	0
I.E.6	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	0	1	43	0	0	0	0	0	44	0	0
Adequate Drain.	DNRC	0	0	0	3	0	2	0	0	0	3	0	2
on Aband. Roads	FED	0	0	1	2	2	7	0	0	1	4	0	7
I.E.8	IND	0	0	1	2	0	11	0	0	0	3	0	11
	NIP	0	0	0	1	0	12	0	0	0	1	0	12
	Total:	0	0	2	8	2	32	0	0	1	11	0	32
HARVEST DESIGN													
Logging Suits	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Topography	FED	0	0	1	11	0	0	0	0	1	11	0	0
II.A.2	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	0	1	43	0	0	0	0	1	43	0	0
Skid Trail	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Design	FED	0	0	1	11	0	0	0	0	1	11	0	0
II.A.5	IND	0	0	2	12	0	0	0	0	1	13	0	0
	NIP	0	1	0	12	0	0	0	1	0	12	0	0
	Total:	0	1	3	40	0	0	0	1	2	41	0	0
Landing Size	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Location	FED	0	0	0	12	0	0	0	0	0	12	0	0
II.A.6	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	0	0	44	0	0	0	0	0	44	0	0
OTHER HARVEST ACTIVITY													
Skid to Min.	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Displacing Soil	FED	0	1	0	11	0	0	0	1	0	11	0	0
II.C.1a	IND	0	0	0	13	1	0	0	0	0	14	0	0
	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	1	0	42	1	0	0	1	0	43	0	0

1996 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Skid to Min.	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Compacting Soil	FED	0	0	0	11	0	1	0	0	0	11	0	1
II.C.1b	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	1	11	0	1	0	0	1	11	0	1
	Total:	0	0	1	41	0	2	0	0	1	41	0	2
Adequate Drain.	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
for Skid Trails	FED	0	0	1	11	0	0	0	1	0	11	0	0
II.C.2a	IND	0	0	2	10	0	2	0	0	1	11	0	2
	NIP	0	0	2	11	0	0	0	0	1	12	0	0
	Total:	0	0	5	37	0	2	0	1	2	39	0	2
Adequate Drain.	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
for Landings	FED	0	0	0	12	0	0	0	0	0	12	0	0
II.C.2b	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	0	0	44	0	0	0	0	0	44	0	0
SITE PREPARATION													
Brush Blades	DNRC	0	0	0	3	0	2	0	0	0	3	0	2
Used	FED	0	0	0	6	0	6	0	0	0	6	0	6
II.D.2	IND	0	0	0	4	0	10	0	0	0	4	0	10
	NIP	0	0	0	9	0	4	0	0	0	9	0	4
	Total:	0	0	0	22	0	22	0	0	0	22	0	22
Scarify Only	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
to Extent	FED	0	0	1	9	0	2	0	0	0	10	0	2
Necessary	IND	0	0	0	14	0	0	0	0	0	14	0	0
II.D.4	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	0	1	41	0	2	0	0	0	42	0	2
Compaction and	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Displacement	FED	0	0	1	8	0	3	0	0	1	8	0	3
Minimized	IND	0	0	1	13	0	0	0	0	1	13	0	0
II.D.5	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	0	2	39	0	3	0	0	2	39	0	3

1996 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Dozer Operation	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
on Suitable	FED	0	0	0	9	0	3	0	0	0	9	0	3
Slopes Only	IND	0	0	0	13	0	1	0	0	0	13	0	1
II.D.6	NIP	0	0	0	11	0	2	0	0	0	11	0	2
	Total:	0	0	0	38	0	6	0	0	0	38	0	6
Limit WQ Impact	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
of Fire	FED	0	0	0	10	0	2	0	0	0	10	0	2
II.D.9	IND	0	0	2	11	0	1	0	0	1	12	0	1
	NIP	0	0	2	11	0	0	0	0	0	13	0	0
	Total:	0	0	4	37	0	3	0	0	1	40	0	3
STREAM CROSSINGS													
Proper Permit	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Obtained	FED	0	0	0	7	0	5	0	0	0	7	0	5
III.A.1	IND	0	0	0	7	0	7	0	0	0	7	0	7
	NIP	0	0	0	7	0	6	0	0	0	7	0	6
	Total:	0	0	0	26	0	18	0	0	0	26	0	18
STREAM XING DESIGN													
Cross Stream	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
at Right Angle	FED	0	0	0	7	0	5	0	0	0	7	0	5
III.B.1a	IND	0	0	0	10	0	4	0	0	0	10	0	4
	NIP	0	0	0	7	0	6	0	0	0	7	0	6
	Total:	0	0	0	29	0	15	0	0	0	29	0	15
Reduce Concen.	DNRC	0	0	1	4	0	0	0	0	0	5	0	0
of Runoff	FED	0	0	3	4	0	5	0	1	2	4	0	5
III.B.1b	IND	0	0	2	8	0	4	0	0	1	9	0	4
	NIP	0	3	2	2	0	6	0	2	2	3	0	6
	Total:	0	3	8	18	0	15	0	3	5	21	0	15
Avoid Unimproved	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
Crossings	FED	0	0	0	7	0	5	0	0	0	7	0	5
III.B.2	IND	0	0	0	10	0	4	0	0	0	10	0	4
	NIP	0	0	0	8	0	5	0	0	0	8	0	5
	Total:	0	0	0	30	0	14	0	0	0	30	0	14

1996 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
STREAM XING INSTALLATION													
Min. Channel	DNRC	0	0	0	4	1	0	0	0	0	5	0	0
Disturbance	FED	0	0	0	6	0	6	0	0	0	6	0	6
III.C.1	IND	0	0	0	10	0	4	0	0	0	10	0	4
	NIP	0	1	0	15	1	6	0	1	0	5	1	6
	Total:	0	1	0	25	2	16	0	1	0	26	1	16
Culverts Conform	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
to Streambed	FED	0	1	0	5	0	6	0	0	1	5	0	6
Slope	IND	0	0	0	10	0	4	0	0	0	10	0	4
III.C.2	NIP	0	0	1	4	0	8	0	0	1	4	0	8
	Total:	0	1	1	24	0	18	0	0	2	24	0	18
Prevent Fill	DNRC	0	0	0	4	0	1	0	0	0	4	0	1
Erosion	FED	0	0	3	3	0	6	0	1	2	3	0	6
III.C.3	IND	0	0	2	7	0	5	0	0	1	8	0	5
	NIP	0	3	1	3	0	6	0	3	1	3	0	6
	Total:	0	3	6	17	0	18	0	4	4	18	0	18
Adequate Cover	DNRC	0	0	0	3	0	2	0	0	0	3	0	2
for Culverts	FED	0	0	0	6	0	6	0	0	0	6	0	6
III.C.5	IND	0	0	0	9	0	5	0	0	0	9	0	5
	NIP	0	1	0	4	0	8	0	0	1	4	0	8
	Total:	0	1	0	22	0	21	0	0	1	22	0	21
HAZARDOUS SUBSTANCES													
Proper Storage	DNRC	0	0	0	5	0	0	0	0	0	5	0	0
and Disposal	FED	0	0	0	14	0	0	0	0	0	14	0	0
V.A.2	IND	0	0	0	13	0	1	0	0	0	13	0	1
	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	0	0	45	0	1	0	0	0	45	0	1
GRAND	TOTALS:	0	24	109	1501	7	427	0	29	72	1537	3	427

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